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THE REIGATE SHEET OF THE ONE-INCH ORDNANCE SURVEY

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THE REIGATE SHEET OF THE ONE-INCH ORDNANCE SURVEY

A STUDY IN THE GEOGRAPHY OF THE SURREY HILLS

BY

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PREFACE

THE following pages are in part the outcome of an effort to understand and correlate the surface features and underlying structure of a stretch of country easily accessible from London. Considering the limited area, the structure presents an unusually large variety of types. This variety is reflected in the topographical forms, vegetation, and even to some extent in the occupations of the people, though the last-mentioned consideration was, for obvious reasons, more marked before the Industrial Revolution of the nineteenth century than it is at present. In attempting to pass in review the more salient features, I am conscious how inadequately the various points touched upon have been treated. An exhaustive treatment was not within the scope of a book like the present. Nevertheless, it is hoped—at a time when detailed topographical study forms an important part in the geography of our advanced classes, and when regular field excursions are becoming common in all colleges and schools—that the following

pages may prove of interest to many who have not the time to make an analysis of the various surface features for themselves.

Though the extent of surface described is confined to the area represented by a single Ordnance Sheet, this should not in itself be a drawback, for most of the features dealt with are shared in some degree by the whole of South-Eastern England.

I take this opportunity of offering my warm thanks to Mr. Mackinder and Mr. Sargent for help which has extended over many years ; and to Mr. Sargent especially for his unfailing assistance with criticisms and suggestions for this book.

In revising the book for the press I have had the valuable help of Professor Lyde and of Dr. H. R. Mill, whose kindness I gratefully acknowledge.

My gratitude is also due to Mr. MacAlister for suggestions on the Geology ; to Mr. Clement Reid for help concerning the origin of Dry Valleys ; to Mr. Gwinnell for his kindly criticism of the section dealing with Vegetation ; to Mr. J. Tempest Harvey for notes on the primitive Iron Railway, as well as for various explanatory photographs ; and to Mr. G. W. Lamplugh for his descriptive Memoir on the Geology of Surrey.

And, lastly, my thanks are due to many unknown friends who, by their ready help, made light and pleasant the tramping of over 200 miles of country—from the rich landed proprietor who gave permission to follow river windings and search for " swallow " holes in his private grounds, to the little gipsy-girl who led me into the depths of the wood to find charcoal-burners, or to the small cow-boy who bade me tend his herd whilst he posed for a " snapshot " in a neighbouring chalk " dimple." To each and all my warmest thanks are due.

E. S.

Skinners' Company's School for Girls,
Stamford Hill, N.
June, 1910.

NOTE

The area treated in this book corresponds with that represented by the Reigate Ordnance Sheet, No. 286, and covers approximately 216 square miles. It extends from latitude 51° 9′ 50″ N., corresponding roughly to the parallel of Newdigate, to 51° 20′ 15″ N., exactly in the parallel of Oxshott and Fairmile Station on the Claygate and Effingham Branch Line. The area thus arbitrarily defined, and sharing as it does its general characteristics with the remainder of South-Eastern England, can in no sense lay claim to geographical unity.

As regards longitudinal extent, it stretches from 0° 0′ 30″ W. to 0° 25′ 20″ W. Its eastern boundary is thus roughly in the meridian of Greenwich, whilst its western is approximately in that of Walton-on-Thames, or of Goring, near Worthing. It therefore lies between Brighton, Shoreham, and Worthing, and the Capital. The best way of realising its position in relation to the south is to ascend Leith Hill on a clear day, when the Shoreham Gap

appears distinctly on the sky-line, and Chanctonbury Ring no less definitely helps to decide the position with regard to Worthing.

The area is one lying almost entirely in the basin of the Thames, the only exception being in the south-west corner, where the little obsequent Oke contributes water to the English Channel by means of the Arun, of which it is a tributary.

As regards climate, it shares in that equability characteristic of almost every part of the British Isles. The rainfall statistics found in the Appendix show that, on the whole, as would be expected, the north-west corner is the driest, the average amount, computed on a ten years' basis, being only 23·4 inches.

It is rather unfortunate that in an area boasting of an altitude of 967 feet (Leith Hill) the highest point at which any rainfall data seem to be forthcoming is only 610 feet (Denbies). As the summit of Leith Hill is sometimes enveloped in cloud, when both Box Hill and Denbies are comparatively clear, it may be fairly assumed that its rainfall would far exceed that of any other place on the list.

The rainfall of Joldewynds (550 feet) is interesting, not only because it heads the list with an average of 32·8 inches, but also because it is the highest representative of the Leith Hill area.

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Under elastic band at end of book.

INTRODUCTION

The organised study of geography in the Universities of this country dates from the foundation of the Oxford School of Geography only eleven years ago. The demand for secondary teachers with a special knowledge of the subject has markedly increased in the last three or four years, with the result that an appreciable number of students now frequent the geographical class-rooms of the Universities. A curriculum is therefore beginning to take shape, based on British experience, and not merely adapted from foreign models. In the two schools of geography with which I have been connected—at Oxford and in the London School of Economics—three stages of work have become habitual. The students follow courses of lectures, and learn the argument of the subject and the nature of the material with which they have to deal. Then in the map-room they learn to read and write the cartographical language. Finally, each undertakes a geographical composition re-

lating to a limited and accessible district. The study of the Reigate Sheet of the Ordnance Map published in this book originated in this way at the London School of Economics. It has since been expanded. Apart from a careful study of maps and other published authorities, Miss Smith has visited every locality in the district, and made herself minutely familiar with every square mile of it—a fact which will, I think, be evident from the decision and graphic insight with which she has ordered her material.

The book is issued by Messrs. Black on behalf of the School of Economics for use as a type in connection with the geographical classes there, but I am not without hope that it may be of service also in other quarters. It may be regarded as an instalment of the scheme proposed some years ago by Dr. H. R. Mill for the regional description of the United Kingdom. He initiated the work with his well-known description of the Arundel Sheet of the Ordnance Survey, but adequate funds were not forthcoming at the time for its prosecution. Perhaps the various University Schools of Geography, by some considered plan of co-operation, may yet fulfil the idea. Until this spade-work has been accomplished, no exhaustive book on British Geography will be possible.

One other point there is, suggested by Miss Smith's essay, to which I will refer. The Historical Geography of the greater part of England should be based rather on a study of the manors than of the parishes. The manors represent the early settlements, as related to water-supply and agriculture. The parish, as is well known, more often than not includes a group of manors. The parish records are, for the most part, relatively accessible. Not so the records of the manors, which are in the main private property. We have, of course, admirable discussions relating to selected manors ; but a systematic survey of the manors of England on which to base a critical manorial map is a desideratum. It can probably only be accomplished as a national work, having regard to the private character of the documents involved. In the meantime something might perhaps be done by properly equipped University students in their several areas. In the present instance, however, Miss Smith has been obliged to issue her study without a chapter on the manors of the area, for the delay involved would have been great, and the result of a search for documents uncertain.

H. J. MACKINDER.

London School of Economics,
May, 1910.

Valentine & Sons, Ltd.

Leith Hill, Surrey.

A STUDY IN THE GEOGRAPHY OF THE SURREY HILLS

CHAPTER I

GEOLOGY

As the topographical features of this area, together with the vegetation, direction of the roads, and in no small degree the distribution of population are influenced by the geological structure, it may be well briefly to consider this first.

On the whole the structure is very simple, the area forming a portion of the great Wealden uplift which stretches nearly due east and west throughout this sheet. As this simplicity, however, is rendered less conspicuous by irregularities arising from unequal weathering of the constituent rocks, it will be necessary to explain something of their chemical composition, texture, and the general conditions under which they were laid down.

The most recent rocks are in the north-west corner, and the oldest in the south-east. Thus, if we walk from Felcourt, south of Lingfield, in

the south-east, to Cobham, in the north-west corner, we pass over the outcrops of every formation, as tabulated below, in the order in which the rocks were laid down.

We will now proceed to examine the various formations in some detail.

WEALD CLAY. These beds are composed of fine clays interstratified with layers of sand and calcareous mud, such as might be laid down in the estuary of a great river. Some of these sands and muds are indurated into stone sufficiently hard to be used either for road metal or building stone. The fossils peculiar to this formation prove *directly* that the deposit is estuarine, and *indirectly* that the land underwent considerable oscillation between the Wealden Clay period and that known as Eocene, for in the interval there existed the deep Chalk Sea, probably lasting over a very long period.

The fossil which proves beyond doubt that the deposit was laid down under fresh-water conditions, is a small univalve mollusc of genus *Paludina*, similar to that which may be found in Thames mud to-day. The presence of this fossil gives its name to extensive stretches of limestone in the south and south-east of the sheet, as shown in Map I. The stone is composed of myriads of little shells firmly

GEOLOGICAL FORMATIONS—MAP I.

	Formations.	*Divisions.*
Quaternary, or Post-Tertiary. — *Pleistocene.*	Recent.	Alluvium (river deposits).
	Old River Drift.	Brick-earth. Gravel and Sand.
	Surface Deposits (of doubtful age) on Chalk Tract.	Brick-earth. Clay with Flints.
Cainozoic, or Tertiary. — *Eocene.*	Bagshot Beds.	Upper. Middle, or Bracklesham. Lower.
	London Clay.	
	Lower London Tertiaries.	Blackheath (Oldhaven). Woolwich and Reading. Thanet Sand.
Mesozoic, or Secondary. — *Upper Cretaceous.*	Chalk.	Upper. Middle. Lower.
	Selbornian.	Upper Greensand. Gault.
Lower Cretaceous.	Lower Greensand.	Folkestone Beds. Sandgate Beds. Hythe Beds. Atherfield Clay.
	Wealden Strata.	Weald Clay with Horsham Stone. Tunbridge Wells Sand. Wadhurst Clay.

compressed together. Being very loose in texture and highly calcareous in composition, it is neither capable of taking a polish, like the similarly-formed Purbeck Beds, nor of resisting the action of the weather.

LOWER GREEN-SAND.

This term "Greensand" is misleading as regards both colour and texture of the formation, for it is not generally green, and frequently assumes the character of clay rather than sand. The formation differs materially from chalk in being extremely varied, in both the vertical and horizontal directions. It therefore gives rise to topographical features widely different in one part of the sheet from those which prevail in another. An exposure in a quarry near Gomshall Station gives a good example of "false" or current bedding so characteristic of these beds, indicating that the Lower Greensand Sea was swept by sufficiently strong currents to interfere with the horizontality of the strata (Plate II.). As the deposit, taken as a whole, assumes so many different characters—now sand, now clay, now indurated sandstone,—and as for convenience it has been subdivided under the names hereafter mentioned, a somewhat detailed account of each member of the series is necessary.

The lowest member, resting directly on the Wealden Beds, is known as *Atherfield Clay*, small

inliers of which may be found in the Leith Hill district. Here the fossils are such as show that a depression of the land had taken place about the end of the Wealden Clay period, for they are no longer of the fresh-water type.

The *Hythe Beds* come next. Their outcrop extends in a narrow belt from east to west throughout the whole area, being widest in the Leith Hill range. They consist in Surrey of loosely consolidated sand of little economic value, though in the Leith Hill area it is more compact than in the region between Reigate and Dorking, a difference distinctly reflected in the topography of the two areas.

Sandgate Beds.—There is a very good exposure of these near Nutfield, where the lack of uniformity in the vertical direction is well demonstrated (Plate V.). This exposure is about forty feet in depth, and is seen to consist of alternate layers of sandstone and clay. The clay, which is known as "Fullers' Earth," will be dealt with more fully under *Industries*.

Folkestone Beds.—These consist generally of incoherent sands of varying colour. In some places they are of a pale buff, whilst in others they incline more to brown or reddish tints, according to the amount of ironstone they contain. Exposed sections often present irregular bands of

thin ironstone, well shown in a cutting near Tandridge and common in the Reigate and Abinger districts. This ironstone is to be seen collected in heaps by the roadside, and is locally known as car-stone.

The Folkestone Beds usually give rise to heaths and commons, as they are too poor to pay for cultivation.

GAULT and UPPER GREEN-SAND.

It is convenient to consider these together as Selbornian. The deposit is of a bluish-green calcareous mud or clay. Its green colour is due to the presence of granules of glauconite. Being of a highly calcareous nature, it is unable to resist erosion, and has therefore worn down more rapidly than the adjoining formations. It attains its greatest thickness apparently towards the east of the sheet, where, in a boring at Caterham, a thickness of 343 feet has been proved. It thins out considerably west of Dorking, where it is in places somewhat difficult to trace.

CHALK. This was laid down under deep-sea conditions, which, judging from the thickness of the deposit, probably continued over a very long period. The outcrop is narrower in the western portion of the sheet than towards the eastern, being about three miles in the meridian of Abinger and five and a half in that of Epsom. This differ-

ence in width of outcrop is due to a corresponding difference in dip, the outcrop being widest where the dip is least, and *vice versa*.

Chalk is remarkable for its uniformity, both vertically and horizontally—a fact which has had most marked results on the general configuration of the area (Plate III.).

It is, however, possible to distinguish the Upper, Middle, and Lower Chalk Beds by the character of their fossils. There is a particularly good exposure of the Upper Chalk a quarter of a mile north-west of Burgh Heath Station, where four distinct layers of flint about a yard apart may be seen (Plate III.). Here also is possible evidence that this formation was much eroded before the deposition of later beds, for where the pebbly clay rests upon it, its surface presents a very jagged appearance, forming a succession of solution pockets, the largest of which is some seven or eight feet deep. However, it is also possible that this degradation went on *simultaneously with*, or perhaps *subsequently to*, the deposition of later beds. Evidence furnished in these Burgh Heath quarries is in favour of the latter explanation, for had the jagged surface been completed before the later clays were laid down, any stratified matter they might contain would be observable at practically the same level in each pocket. This is not the case, for in the

large pocket alluded to above, a layer of pebbles, which have the rolled appearance and size of those peculiar to Blackheath Beds, makes a downward curve roughly coincident with the concave surface of the depression, but separated from it by a thin layer of clay.

On the assumption that the pocket alluded to was caused by gradual dissolution of the chalk, owing to downward percolation of surface waters, any stratified material resting upon it would adapt itself to the concavity of the gradually lowering surface ; hence the loop-like curve of pebbles shown in the picture.

LOWER LONDON TERTIARIES.

The *Thanet Sands*, which were probably laid down uniformly all over the Chalk, have in most cases been washed away seawards. However, a succession of four isolated patches between Banstead and Walton-on-the-Hill has survived—probably not because of any superior resistancy which the formation might possess, but because it happened to lie on the watershed of the old drainage system between the Chipstead Valley streams and the rivers draining towards the north-west into what is now represented by the Mole system. These patches would thus be out of reach of the much severer erosion to which similar deposits in the lower valleys were subjected, in a way which will be explained later.

A comparison between Maps I. and II. will help to illustrate this point.

Other outcrops of Thanet Sand are to be seen underlying the Woolwich and Reading Beds, between Epsom and Leatherhead, and also supporting the three patches mentioned below.

WOOLWICH and READING BEDS.

These have been washed away from the four Eocene areas west of the Chipstead Valley system, but are still preserved in three isolated patches on a tongue of elevated land, coloured yellow on the relief map, and still better shown side by side with the geological formations on the two-inch map of the Mole Gap, No. III. Through this deposit the road between Headley Church and Leatherhead has been cut. It passes over what is locally known as Oyster Hill, where in spring, after the winter frosts have broken up the soil, good specimens of the *Ostrea bellovacina* can be found, thus proving beyond question the identity of the deposit. By referring to the coloured relief map, No. II., it will be seen that these isolated patches, like those of the Thanet Sand previously described, are on a small watershed, and have been allowed from the same cause to stand as monuments of bygone geological conditions.

A more considerable outcrop of this deposit stretches diagonally across the north-west portion

of the sheet, from Epsom to some distance west of Effingham.

BLACKHEATH BEDS. There are small outlying patches of these to the south and east of Caterham, the largest being that occupied by Worms Heath. The beds consist of well-rolled flint pebbles, often firmly compacted together in a matrix of calcareous clay, thus forming a hard conglomerate or pudding-stone. From the absence of subangular flints, and from the much-worn appearance of the pebbles, it is inferred that they have been transported over a considerable distance before being laid down.

The fossils, varying from fresh-water to brackish types, show that the land was still in an unstable condition at the time of their deposition.

LONDON CLAY. This is a marine deposit found on either side of the Mole Valley, in the north-west of the area. It is of a bluish colour when fresh, but turns brown by exposure to the atmosphere. In it are frequently found nodular masses of clayey limestone, or "turtles" as they are locally called. The fossils are such as to indicate a warm, almost sub-tropical climate.

BAGSHOT BEDS. As these are but poorly represented, a passing notice may suffice. Like the Lower Greensand, they vary considerably in the vertical direction, assuming at intervals the char-

acter of clay in the middle division of the series. In them, as well as in the Woolwich Beds, are found consolidated masses of pudding-stone, often called sarsen stones or "grey-wethers," from their fancied resemblance to sheep (Plate X.). Specimens of such stones lie scattered over the area under consideration. They have been probably used in the past as landmarks or boundaries on the fenceless Downs.

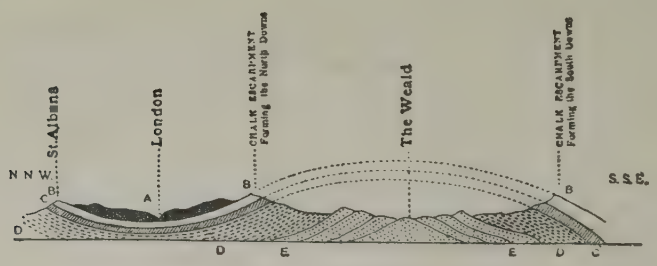
PLEISTOCENE DEPOSITS. With regard to Pebble-beds and Hill-gravels strewn about over the formations already mentioned, it is now generally supposed that they are of fluviatile origin, as the once popular idea that the whole area was worn down by marine erosion has little to recommend it. The existence of these beds speaks of a time when the present hills were the valleys of a previous drainage system. The most extensive deposits of this age are over the Chalk Downs, where they give rise to distinctly different types of vegetation from those prevailing on pure chalk.

This section cannot be closed without some reference to various "faults" in the area. The most considerable is the one shown on Map I., between Merstham and Earlswood. This has been closely followed by the South-Eastern and Chatham Railway.

A few miles to the east of Dorking is the well-

known Rookery Fault, the down-throw of which, amounting to 100 feet, lies to the north. Reference to Map I. will show that, whilst the Reading branch of the South-Eastern and Chatham Railway keeps to the northern edge of the Selbornian series in its earlier stages, it passes almost imperceptibly to the southern edge of the same series, to the west of the disturbance. A careful observation of the topographical features before and after the Rookery Fault reveals marked differences in the two sections of the country adjoining the line.

A third fault worthy of mention is that near Betchworth.



SECTION ACROSS SOUTH-EAST ENGLAND.

A = London clay. DD = Weald clay mainly.
BB = Chalk. EE = Hastings sand.
CC = Lower greensand.

The dotted lines indicate the original upfold of the rocks before erosion took place.

CHAPTER II

TOPOGRAPHICAL FEATURES

The various topographical features are due in the main to the tilting up, and subsequent unequal weathering, of the strata just described. The most conspicuous of these features is without doubt the Chalk escarpment, for it stretches, with only one break, throughout the area from east to west, and, with one exception in the south-west quarter, dominates all the formations of the southern half.

The exception just referred to is a feature so important that it deserves special mention. Leith Hill, in the Greensand ridge, attains a height of 967 feet above sea-level. The highest point reached by the Chalk is 877 feet, near Flinthouse Farm, north of Oxted.

A very good idea of the angle of dip, and of the way in which the Greensand ridge gradually sinks under the Chalk, can be obtained by standing, on a clear day, at a point near Tilburstow Hill, some fourteen miles to the east of the ridge which cul-

minates in Leith Hill. At this distance the difference in height between the two escarpments is scarcely perceptible, but it is instructive to see them silhouetted against the sky from one standpoint, as this helps better than anything else to make one realise how successive layers have been gradually eroded away, and how the upstanding formations, which are geologically lower than those under which they dip, may be at the same time geographically higher.

Leith Hill is important as containing headstreams which contribute to three larger rivers—the Tillingbourne to the Wey, the Pipp Brook to the Mole, and the Oke, a little obsequent stream south of Holmbury, to the Arun. It is thus a watershed between streams flowing into the Thames and those draining into the English Channel.

Holmbury Hill, with a height exceeding 800 feet, forms part of the Greensand ridge, and is separated from Leith Hill by the Oke Valley.

Relief Map No. II. shows only four other elevations, besides those just mentioned, which rise to over 700 feet. The whole area is therefore one of moderate relief, and is such as Professor Davis describes as a peneplain of subaerial denudation. The areas given above as being over 700 feet, are separated from each other by notches, which have

been of the greatest service in facilitating communication between north and south. These notches are the Caterham Gap, affording a road from Croydon to Godstone; the Merstham Gap, affording the shortest route between London and Brighton; and the Pebblecombe Gap, giving to Headley, Walton-on-the-Hill, and other places on the Chalk uplands of the central portion, an outlet towards the south.

Leaving the uplands for a short time, we will now descend into the Mole Valley. It stretches diagonally throughout the sheet from south-east to north-west, contracting slightly near Leigh, and again more markedly between Dorking and Leatherhead, where it has secured a passage through the whole breadth of the Chalk ridge. This valley is shown mainly by the two contour lines of 200 feet, which are among the most conspicuous in the whole area. Only in the north-west corner does the valley sink below the 100-foot contour line.

There are other valleys marked on Map II. of great interest, as showing a halt in the cycle of erosion which helped to wear down this area to a peneplain. These valleys, though once occupied by periodically energetic streams, as we may judge by the size and quantity of pebbles which have in some cases been left stranded in their bottoms, are now

free from standing water even after heavy rains. The Caterham and Smitham Valleys, however, seem to stand in a position midway between those which are always dry and those which are occupied by a stream only slightly intermittent, like the Mole. They are periodically occupied by running streams, which are known as "bourne-flows," in connection with which an atmosphere of mystery and superstition has gathered, which associates the flow with dreadful political events or national disaster.* It does not require much imagination to understand that these bourne-flows, which are common in many parts of England, are due to a period of unusually heavy rain, occurring at a time when the loss by evaporation is reduced to a minimum. The ground gets saturated to unusually high levels, and as a natural consequence, the springs issue forth in unusual places ; but as in this particular instance the flow can be predicted—with a tolerable degree of certainty several weeks before it actually

* In the Coiron region of France, where a sheet of basalt rests on limestone, near Darbres, a similar phenomenon is to be found. Here are *two* streams only a few yards apart, and alternately intermittent. When the higher of the two springs sends forth water, the lower ceases to flow, and *vice versa*. Human nature, so strikingly alike all the world over, ascribes calamity to the flow of that stream which occurs with lesser frequency. Hence the lower and more equable stream is called "*la Paix*," and the other "*la Guerre*" ("Le Vivarais," by Louis Bourdin, p. 86).

1. Quarry in Lower Greensand at Gomshall Station. The holes near the surface show sand-martens' nests.

2. Same quarry as No. 1. "False" bedding is well seen above the basket (p. 4).

takes place—by anyone who will take the trouble to observe the rise of level in the neighbouring wells, and as the lower part of the valley is filled with discontinuous pools several weeks before the upper valley is occupied by a running stream, there is no need to go out of one's way to explain the phenomenon by so elaborate a theory as that which supposes the water to be suddenly siphoned out of some natural reservoir hidden within the chalk.

These periodical flows are, in short, the exact counterpart of the " swallows " which are common in all limestone regions. The former occur when precipitation is highest and evaporation lowest, whilst the swallows are best observed at the opposite season of the year.

There is good reason to believe that in days gone by, when the general plane of saturation was higher, and wells were not usually sunk as deep as at present, the Bourne of the Caterham Valley was of a volume such as to agitate the public mind more than it does to-day.* Since the last re-

* Lovers of folk-lore will be interested in the following extract from Warkworth's Chronicle of the thirteenth year of Edward IV. (1473) :' ' Englyschmen, whenne thei dyd fyrst inhabyde this lond, also sone as thei see this watere renne, thei knewe wele it was a tokene of derthe, or of pestylence, or of grete batayle ; . . . whenne it betokennethe batayle it rennys foule and trouble watere ; and whenne betokenythe derthe or pestylence it rennyth as clere as any watere, but

corded flow, in 1904, two deep well-borings have been made in the neighbourhood, and it is not anticipated that the present flow (1910) will be very great, in spite of the heavy rainfall of the past season. Moreover, the boring of the Oxted Tunnel has diverted a portion of the drainage of this area towards the south by a small obsequent stream which flows towards Oxted.

That the ancient streams of this district once flowed over the Lower Greensand, which must therefore have been either flush with or higher than the Chalk ridge, is proved, as Professor Prestwich points out, by the fact that rolled pebbles of chert and ragstone, such as exist only in the Sandstone ridge, can be picked up from Smitham Bottom and other places where river gravels from the system abound.

The north-east quarter of the sheet is entirely filled with a complex system of similarly abandoned valleys, converging towards Purley, just outside the northern margin of the area. The contours of this quarter resemble in their many ramifications the roots and rootlets of a great tree, the trunk and upper portions of which are hidden from view.

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this yere it ranne ryght trouble and foule watere." John Aubrey also chronicles Bourne-flows before the Plague of 1665, and again before the coming of William of Orange.

As we shall see in dealing with communications, such a system of natural trenches is not without its influence on the surrounding area, especially in providing easy access to the south, south-east, and south-west. The Woldingham Valley, though one of the deepest, has been of little use to railway engineers, probably because of the sharp curve between Warren Barn and Bug Hill Farm (Map IV.). The promoters of the Croydon, Oxted, and East Grinstead Railway preferred to carry their line up the valley midway between the Woldingham and Caterham Valleys, as by this means they could ensure a more direct route.

The Merstham and Chipstead Valleys will be dealt with more fully in the section on communications.

Three east-to-west valleys tributary to the Chipstead system have already been alluded to in the chapter on Geology, as having been occupied by streams too feeble to wear away entirely the Eocene deposits between Banstead and Walton-on-the-Hill.

Viewing these worn-down deposits of Thanet sand side by side with the scooped-out valleys below them, helps us in some measure to realise how the process of sculpturing the land into its present form was brought about. The head-streams, when not held back by frost, would be ever

gnawing away at any superficial deposits on Chalk within their reach. A vast amount of sand, pebbles, and other débris would be transferred to their waters; and, thus equipped with efficient tools, they would be enabled to deepen their valleys at a rate which we find it difficult to conceive of as we stand in sight of their abandoned trenches.

Towards the west, the northern half of the area is not nearly so diversified in superficial outline as the region just described. Opening into the Mole Gap there are two dry valleys, leading to Headley and Tanners' Hatch respectively. The former must have been deserted by its stream at a fairly early date, for its head-waters have not only failed to take away deposits of Thanet Sand, as in the case of the streams just considered, but they have left a considerable depth of the superimposed Woolwich Beds, which are shown best on an elevated tongue of land on Map. III.

All the dry valleys thus delimited are sharply incised in the Chalk Downs, and are separated from one another by very definite interstream spaces of almost uniform height.

Their most striking characteristics are :

(*a*) Disparity between the size of the valley and probable size of the stream by which, judging from the catchment area, it was once occupied.

1. This exposure of chalk at Oxted illustrates the remarkable uniformity of the formation (p. 7).

2. Chalk-pit near Burgh Heath Station. The dark pocket is filled with a residual clay. Two crosses towards the left show small "fault" line (p. 7).

(*b*) Approximately U- rather than V-shaped profile in cross section.

(*c*) General absence of rolled flints or other insoluble material in the valley bottoms.

(*d*) Absence of raised terraces.

Nor are such valleys entirely confined to Chalk, for in the Leith Hill area to the south-west a few small ones are found in the Greensand, *quite dry*, whilst others are occupied in their upper courses by tiny tricklets of water out of all proportion to the size of the trenches in which they flow. Of the latter, perhaps the best example is the Tillingbourne between Wotton and Broadmoor, though the valley in which Friday Street nestles is scarcely less characteristic. In walking from the Tillingbourne Valley to Abinger Common, one is very much struck with the rapid alternation of ridge and trough; for in this short distance of little more than two miles, three such valleys, with their intervening ridges, are crossed in rapid succession.

The 600-foot contour line roughly marks the height of the upland here. The stream in Abinger Bottom is so diminutive in summer that it could be passed through a 2-inch pipe; yet the valley is incised so deeply that one arrives at the edge of the upland with a suddenness that would be almost alarming were the attention not arrested by the general beauty of the surroundings—a

beauty greatly enhanced by the dark green of the fir-clad heights contrasted with the light green mossy carpet of the valley bottom.

The tendency to a U-shape of the Tillingbourne Valley is well marked near Wotton, where rich meadow-land lines its lower slopes. The interstream space separating the Tillingbourne from the Pipp Brook is so narrow, and at the same time so high, that this part of the Greensand ridge presents perhaps the most marvellous piece of land sculpture on the whole sheet, especially when we regard it in the light of the general looseness of the formation.

Now, it is unbelievable that the bold topographic features above described have been chiselled out under climatic conditions similar to those which prevail to-day. Even if we admit that the catchment area of some of the streams once occupying these valleys extended over the Weald, and that the yearly precipitation was considerably greater than it is at present, we still have to face the question as to why such definite interstream spaces should have apparently withstood the effects of all the agents of erosion combined, whilst the valley spaces have yielded themselves an easy prey to the same. Some of the interstream spaces, as we have seen in the earlier portions of this chapter, are themselves capped with patches of

Thanet Sand and other deposits of Eocene age, whilst the valleys below, though of compact chalk, have been effectually gouged out by some force apparently now inoperative. We need a theory which will satisfactorily explain such seeming contradictions. The problem before us is by no means easy of solution. During the last half-century many theories have been advanced by way of explanation. With regard to the Chalk valleys which are usually dry, one of the latest explanations is known as the "solution" theory. This theory, however, fails to explain why the whole area was not dissolved away to one dead level; nor does it show what became of the insoluble matter, which in the Upper Chalk at least was of necessity dislodged in the process.

The theory advanced by Mr. Clement Reid* twenty-three years ago has generally been accepted by geo-morphologists in this country, though with a slight modification with regard to the temperature which would be necessary to maintain the conditions which he postulates. It has recently been estimated that a fall of but 3° F. in the mean annual temperature of these islands would result in the formation of small glaciers within the area of the Scottish Highlands. Mr. Reid considers this too moderate an estimate, but a few degrees

* *Q. J. G. S.*, xliii., pp. 364-373.

more or less does not alter the main issue of the argument. The late Professor Seeley, in his observations on Ben Nevis during the month of August, several times observed that the nightly precipitation took the form of snow; therefore, as August is one of the warmest months of the year, we may draw our own conclusions as to how near Ben Nevis is to the line of eternal snow.

Whatever may have been the exact temperature of the area we are considering, near the close of the Glacial Period, we are justified in assuming that at the higher levels—say above the 600-foot contour line—the summer sun would fail entirely to thaw the ground more than a few inches below the surface. When at length more genial conditions were ushered in, they would come slowly and almost imperceptibly. Thus, during the greater part of the year the interstream spaces would be spared the active erosion to which the valleys were subjected.

It is not necessary to assume that the annual precipitation was much greater than it is to-day. It may even have been less. If we assume that it took the form of snow rather than of rain, it is easy to understand how deposits of sand and other incoherent matter at high levels, and on fairly flat surfaces, could withstand the combined attacks of all the elements through long periods, whilst the

valleys below were being carved out into their present form. As Mr. Lamplugh* has lately pointed out, the impact of falling snow is so slight, as compared with that of rain, that any substance on which it falls remains practically undisturbed. Moreover, snow acts as a protective cap to those portions of the Earth's surface which it covers. Any diurnal rise in temperature would succeed only in melting surface layers, which at night would return to the solid condition. It would be very different on the exposed valley sides. Here the period during which erosion would receive a check would be of short duration. Diurnal changes of temperature would cause rapid destruction of both Chalk and Greensand, which, from their permeability during a temporary thaw, would be peculiarly susceptible to this kind of erosion.

The icy hand which firmly held the valley slopes by night would, on the approach of milder conditions in the daytime, let fall large quantities of loose material into the valley bottom, there to be finely comminuted, or carried away by torrents of summer thaw-water. Such torrents are experienced at rare intervals in almost any catchment area where part or the whole of the basin is liable to be rendered impermeable by ice. This is espe-

* "Physiographical Notes," by G. W. Lamplugh (*Geographical Journal*, vol. xxxiv., pp. 55-59).

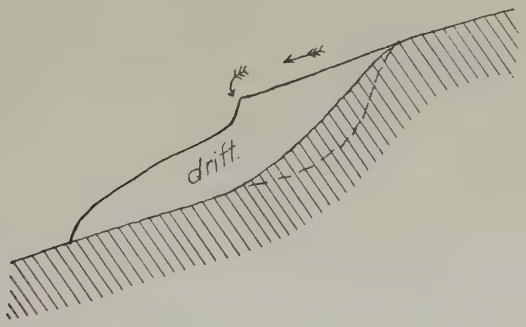
cially the case when the accumulated precipitation of a few weeks, having been stored up in the form of snow, is followed by an unusually heavy precipitation of rain. Such torrents of thaw-water as might occur when a *whole season's* precipitation had at short notice to be carried off seawards, would have sufficient force to scour completely all débris from the valley bottoms—at least, in the higher valleys. Erosion would thus go on in the stream channels at a rate difficult for us to conceive of—at a rate which, as Mr. G. Clinch has recently shown, sometimes resulted in "breaking down the divisions between adjacent valleys and the formation of isolated hills."*

An excellent example of such a succession of isolated hills is to be seen between the Pipp Brook and Milton Brook Valleys, south-west of Dorking and Westcott, where three remnants of a once continuous ridge, still intact on the eastern side of the Upper Pipp Brook, stretch towards the Rookery. These three hills, of which the highest reaches over 500 feet, are marked on Maps II. and IV.

In connection with the question of erosion by snow, the investigations carried on by an American morphologist, Mr. F. E. Matthes, are extremely interesting.

* "Sculpturing of Chalk Downs," by G. Clinch (*Geological Magazine*, February, 1910).

Mr. Matthes has shown how a V-shaped valley may be transformed into one of the U-type by this process of nivation. Now, as both Chalk and Greensand valleys in our area frequently approximate more to the U than to the V shape, this additional evidence of erosion by snow, considered side by side with Mr. Reid's theory of the protective character of snow, clears up many difficulties



Cross Section of a Steep Snowdrift, showing Recession by Nivation. (After Matthes.)

about dry valleys in our district. Mr. Matthes has shown how snowdrifts, without moving, gradually deepen the bed in which they lie by eating away at the margins during the recession of the drift in summer. The slight increase of temperature by day causes some snow to melt; thus the underlying rock is moistened, and so made an easy prey to the frost by night.

It is to be borne in mind that on the dip slopes

of the North Downs, as well as in the Leith Hill area, the winter snows would melt away tardily, so that the process of nivation might be here continued throughout the summer to lower levels than those we have assumed.

Mr. Matthes' investigations have been followed up in other districts by Professor W. H. Hobbs, of Michigan University, with the result of confirming the observations made by Matthes.

There are comparatively few areas in our own country which have not been heavily glaciated ; therefore surface features presenting the characteristics above described have a special interest to those students of earth sculpture to whom the undulating type of country resulting from glaciation has become familiar.

There is still a wide field of discovery open to those who are willing to follow up this study, for if all the assumptions as given above be correct, we ought to find different resulting topography on the dip slopes of the North Downs from that prevailing on the South Downs, owing to the greater rapidity with which the snow would disappear on the latter. For the same reason, east-to-west valleys should present different surface features on the north from what they do on the south.

Second only in interest to the numerous dry valleys are the many " dimples " and trough-like

1. Chalk "dimple" at Reigate. Notice the graceful contours typical of chalk scenery.

2. Same "dimple" as No. 1. The black speck is a small boy (p. 29).

depressions found all over the Chalk area. They are probably the result of solution by water, and from the fact that they can be found in all stages of development, it seems possible that new ones are continually being formed and older ones enlarged.

A succession of three or four " dimples " extending in one direction is of common occurrence—a fact which seems to suggest that one day they will unite into a long trough. Such a group may be seen to the east of the road leading up Reigate Hill (Plate IV.). They are lined with grass, and free from standing water even after a heavy shower of rain.

The photograph showing these cuplike hollows was taken in spring, after the chain-harrow had left those lighter and darker bands of green, so characteristic of pasture-land in the early months of the year. The graceful curves into which Chalk weathers are thus made appreciable in the picture.

The south-west quarter is occupied almost entirely by the ridges connected with Leith Hill and Holmbury Hill. This is a very diversified area of fir-clad heights, alternating with deeply-incised valleys, the two largest of which are occupied—the one by the Pipp Brook, and the other by the Tillingbourne — consequent streams which, on

nearing the Gault vale, turn respectively to the east and west, thus becoming in their lower courses "strike" or "subsequent" streams.

Compared with the Leith Hill district, the other portions of the Greensand ridge are insignificant. That part between Reigate Heath and Dorking has worn down almost to the general level of the Weald Clay to the south. Nevertheless, the ridge between Redhill and Tilburstow forms a distinct topographical feature, rising in places to over 500 feet above sea-level. There are two very slight elevations on Reigate Heath, surmounted respectively by a windmill and a clump of fir-trees. These small hills stand as sole surviving representatives of once important elevations in this part of the ridge.

We thus see, in reviewing the Sandstone belt from east to west, how very unequal has been the process of erosion. The River Mole is, without doubt, largely responsible for the wearing down of the ridge between Reigate Heath and Betchworth Park; but the reasons for the widely different features in other places must be sought for rather in the formation itself than in the denuding agents which have attacked it.

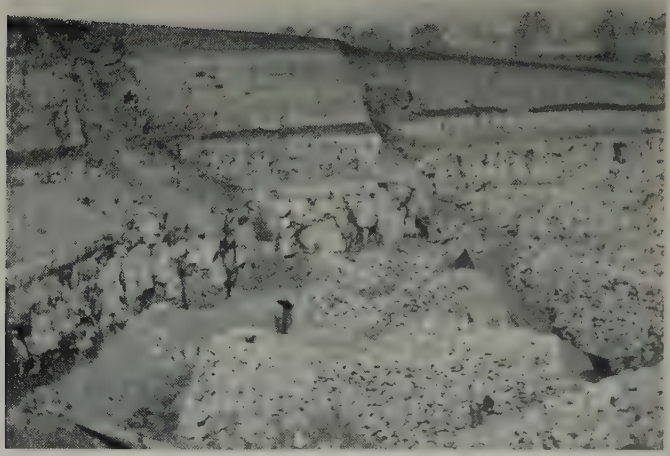
The low Gault vale at the foot of the Chalk escarpment has been scooped out more rapidly than either of the adjacent formations, owing to

its relatively low resisting power. A new system of drainage has, in consequence, been established, resulting in the decapitation of the rivers previously referred to as occupying the Merstham and Caterham Valleys. The Mole appears to have transferred to itself the head-waters of the former, and the Medway those of the latter. So far as the present sheet is concerned, the Mole is the only river which has maintained its "right of way" through the Chalk ridge. There are two possible explanations for this: either, by reason of greater volume, it possessed a proportionately greater eroding power than the decapitated Merstham stream, or it sought escape towards the north, in a part of the ridge more quickly and easily worn down than that chosen by the latter river. Probably the first explanation is the correct one, for, as has been already pointed out, Chalk varies little in texture in any direction.

The swallow-holes of the Mole, the most considerable of which are near Burford Bridge, do not make any distinct feature in the topography of the region. Nevertheless, in summer they so seriously affect the flow of water, that in places the river-bed is perfectly dry for considerable distances; but in winter, when the ground is saturated, and evaporation is at its lowest, the river maintains a steady flow in spite of the swallows.

Aubrey quaintly alludes to what was in his time (1673) regarded as a mysterious habit peculiar to this river by marking on the map prefixed to his History: "*Here the river runneth underground.*"

The swallows are due to the ease with which limestone dissolves in water, and are common in other districts of the same formation.



1. Exposure of Sandgate Beds near Nutfield, where the lack of uniformity in Greensand is well seen.

2. Same quarry as No. 1. When the upper strata have been removed, Fullers' Earth is laid bare (p. 5).

CHAPTER III

VEGETATION

FEW districts of similar extent show the variety of flora found in this part of Surrey. This is due rather to the great variety of subsoils than to any marked climatic differences.

A factor helping considerably towards the same end is that, owing to the great extent of non-water-bearing strata, and therefore of land unsuitable for human occupation, the area abounds in extensive tracts of heaths and commons, some of which have been practically undisturbed since the Norman occupation.

The following is a list of such open spaces :

Milton Heath
Abinger Common
Wotton Common
Coldharbour Common
} on the Lower Greensand.

Ranmore Common
Walton Common
Coulsdon Common
} on Chalk, overlain in places by Clay and Hill Gravels.

Great and Little Bookham Commons
Leatherhead Common
Ashtead Common
} on London Clay.

Worm's Heath : on Blackheath Beds.
Oxshott Heath : on Bagshot Beds.
Headley Heath : on Hill Gravel and Sand.
Burgh Heath : chiefly on Thanet Sand.

On most of the above wastes, xerophytic or drought-loving types of vegetation abound. These are especially well marked on the Lower Bagshot Beds of Oxshott Heath, where the Scots Pine (*Pinus sylvestris*) succeeds in monopolising the ground over large areas ; whilst other parts, devoid of trees, support a thick covering of heather (*Calluna vulgaris*), and the two heaths (*Erica tetralix* and *E. cinerea*), with other smaller types.

The Folkestone Beds, consisting of loose unconsolidated sand, are usually barren wastes supporting a distinctly xerophytic vegetation. Where the Folkestone Beds have been removed from the Lower Greensand ridge, as well as on the Chalk Downs, the flora is usually more varied, but on the whole is still xerophytic, this condition being due to the porosity of the soils.

A comparison of the types found on the two last-named formations shows that neither one nor the other can boast of many peculiar plants, supply of moisture being the controlling factor, rather than what Schimper has called edaphic conditions —that is, conditions arising from properties inherent in the soil. There are, however, some trees

and a few smaller plants which show a distinct preference for Chalk. A list of these will be found at the end of the chapter.

Where Chalk comes to the surface, the two heaths and heather are not found ; they are, however, very abundant on the Greensand, where they are often accompanied by :

Broom (*Cytisus scoparius*).
Gorse (*Ulex europæus*).
Whortleberry (*Vaccinium myrtillus*).

Gorse is especially well developed near Tandridge Church, where may be seen in spring a hedge of it in flower. This reminds one that it was in Surrey that Linnæus, the Swedish naturalist, is said to have gone on his knees, thanking God for having seen such a glorious sight as Gorse in full bloom.* The survival of this well-grown hedge, after so hard a spell of frost as that experienced the last week of December, 1908, speaks well for the sheltered position of Tandridge on the Greensand ridge. The bushes on the elevated Leith Hill ridge fared less well, and present a shabby, ragged appearance—a condition probably due to the exposed position of the hill.

* Gorse is a more sensitive plant than broom, for whilst the latter can live in Northern Europe as far north as lat. 57½°, gorse is killed by a few degrees of continued frost. It is absent on the sand-dunes of Northern Denmark, and therefore probably in Sweden.

The larger types developed on the Greensand are :

Scots Pine (*Pinus sylvestris*).
Austrian Pine (*Pinus austriaca*).
Corsican Pine (*Pinus laricio*).
Wellingtonia gigantea.
Cypress.

The very large variety of introduced types in the south-west is in a great measure due to the interest taken in the preservation and propagation of trees more than two centuries ago by John Evelyn, of Wotton. He travelled much on the Continent, and was instrumental in introducing to his own estate at Wotton Park many types which had not existed there before. These afterwards found their way into other counties. Evelyn's "Sylva," though written so long ago, is still a standard work on English trees. The circumstances under which it was written are of sufficient interest to claim our attention here. As will be shown later, during the Civil Wars of the seventeenth century there had been such destruction of oak-trees in the south-east of England for the production of charcoal as to cause the Navy Office much uneasiness of mind. These fears were embodied in certain queries, which, on being sent to the Royal Society, were handed on to John Evelyn to answer, and his book "Sylva" was the result. The spirit in which Evelyn wrote is reflected on the title-page of his book in these words :

"A Discourse of Forest-Trees and the Propagation of Timber in His Majesty's Dominions as delivered to the Royal Society 15th October, 1662, together with an Historical Account of the Sacredness and Use of Standing Groves."

In places, the Greensand ridge is moist enough to support well-developed deciduous trees. This is easily understood when we remember how very varied in texture is the formation. In other places extensive tracts of coppice occur, whilst in the best managed parts well-grown timber trees intermingle with thick coppice, the latter being cut down for various uses every fourteen or fifteen years (Plate VII.).

At least *three* well-marked oak-tree zones, all on clay, are still traceable. These are: (1) on the Woolwich and Reading Beds in the north-west; (2) on the Gault Clay zone; and (3) on the more extensive Weald Clay, where timbered cottages and churches are especially numerous. It is on the Weald Clay, too, that one notices a preponderance of place-names due to the prevalence of the oak-tree. The following are some of these: Oakdale and Oxted,* Ockley, Oaklands, and Oakley. Oxshott *may* also be derived in the same way.

Some oaks on the Weald Clay have developed

* Oxted in Domesday Book was Acstede.

unusual proportions. A good example is the Lingfield Oak, measuring 25½ feet in girth four feet above the natural level of the ground.

With regard to the narrow Gault zone, it is of interest to recall that, before its present name was fully established, it was for some time known as Oak-tree Clay.

The Ash has been much less extensively cultivated, as is suggested by the relative paucity in place-names derived from this source. Clumps of Ash-trees are, however, found near the farmsteads, for before hand labour was largely supplanted by machinery, ash-wood, by reason of its toughness, was invaluable for many of the smaller implements of agriculture, such as the hay-rake, flail (flagellum) —still used for threshing wheat the straw of which is intended for thatching,—sickle-hafts, cart-shafts, and even parts of the wooden plough. Ashtead, Highashes Farm, and High Ashurst, are interesting place-names.

The Elm grows well on clay formations, but does not appear to have given its name to any places.

The Holly (*Ilex aquifolium*) thrives apparently equally well on Chalk and on Greensand formations ; one would therefore judge *prima facie* that it was a xerophyte. Schimper, however, denies that it is strictly so ; he prefers to call it a tropo-

phyte, or plant that can accustom itself either to dry or moist conditions. It apparently prefers the former, for on both the Chalk and Greensand ridges it attains such proportions as are never to be found on the moist clays of the Midlands and other parts of England. Usually it occurs, not in a single bole, but in a cluster of from four to seven branches, each of which would make a large tree by itself. One specimen on Greensand in the Tillingbourne Valley, near Abinger Mill, measures nine feet in girth, and attains the height of a well-developed poplar-tree. Another specimen near Holmbury, on the same formation, attains a girth of over nine feet, whilst many on Chalk are equally well developed.

The special persistence of this tree in former times throughout the Greensand belt, is reflected by the fact that the zone from Godstone to the western limits of the sheet is known as Holmdale; and in other parts of the same formation the following names occur : Holmwood, Holmbury, and Holmthorpe. Probably, from the occurrence of the name Holmdale or Holmdale Valley over a wide area, the tree was in the early days of settlement of far more frequent occurrence than it is to-day. There are special reasons why too many of the species would not be allowed to remain, for, besides being of a particularly aggressive nature,

it monopolises all the ground it occupies, and its wood is of little economic value.

The Yew, in company with Juniper, is in many places on the Downs the only species attaining the height of a tree. Ewhurst, a parish which appears in the south-west, probably owes its name to the Yew. Ewell, in the north, was formerly Etwell, and therefore probably owes its name to another source. Ewood Farm and Yew-tree Farm explain themselves. Juniper Hill, like Box Hill, is named from the bushes which clothe it.

It is not very probable that the bushes of Box Hill are indigenous, though they have every appearance of being so. On other limestone formations in the country this species attains great size; therefore we may class it with the Beech, Yew, and Juniper, as calciphilous.

The fir-trees of Abinger, Friday Street, Coldharbour, Reigate Heath, and Tilburstow Hill, are probably the surviving representatives of a pine-forest stretching from end to end of the Greensand formation. Names of places derived from this tree are conspicuously absent, and writers have, in consequence, argued that it did not exist at the time of the Saxon occupation, strengthening their arguments by this statement, made by Cæsar: "Materia cujusque generis, ut in Gallia est præter fagum atque abietem" (Cæsar's "Gallic Wars,"

Book V., 12)—a statement generally thought to be wrong.

The Larch (*Abies larix*) thrives well on the Downs where there is a superficial covering of Clay-with-flints. Some attempts at afforestation are being made near Abinger, where young larches may be seen closely packed together in order that the light may draw them up quickly and straight. After a few years' growth they are thinned out, to allow more room for further development.

Among xerophytes not previously mentioned are: Butchers' Broom (*Ruscus aculeatus*), whose leaf processes (cladodes) are arranged in a similar way to those of the Australian Eucalyptus—that is to say, in a vertical plane, or parallel with the rays of light, in order to lose the least possible amount of moisture through transpiration; *Potentilla fragariastrum*, which flourishes well on brick walls and in similarly dry situations; *Potentilla anserina*, or Silverweed, a plant less truly drought-loving than the former, and found usually on marginal spaces such as roadsides; Coltsfoot (*Tussilago farfara*), common on railway embankments, rubbish heaps, and similar waste spaces; Ragwort (*Senecio Jacobæa*), a special pest to farmers, and not found on well-farmed pastures; Harebell (*Campanula rotundifolia*); Yellow Toad-flax (*Linaria*

vulgaris); Wild Thyme (*Thymus Serpyllum*); Marjoram (*Origanum vulgare*).

Ferns, being chiefly moisture-loving, are naturally few on these porous, stream-abandoned soils. Three species, however, may have special mention as having drought-resisting capacity. These are: *Polypodium vulgare;* Hard Fern (*Lomaria spicant*); and Wall-rue (*Asplenium ruta-muraria*).

In the Leith Hill and Abinger districts, where the two former are especially common, the Polypodium often chooses a somewhat elevated position, between the forked branches of a tall tree. By this habit it effectually provides against extinction.

Sedum glaucum, *S. telephium*, and *S. acre* are common, especially on the Greensand. All these adopt a different device for resisting droughty conditions from those already mentioned, for they actually store up moisture in the tissues of their fleshy leaves; and, lest it should prove tempting to the thirsty creatures which run about on these streamless wastes, *S. acre* is provided with cells filled with an acid juice with which to blister the lips of any daring enough to eat it.

The Beech on the Chalk zone, like the Fir on the Greensand, probably once extended over wide areas. Well-known clumps of this species, which form distinctive features in the topography, are

the Betchworth clump, at a height of about 700 feet, and the Reigate Beeches, at about the same level. Many of the dry Chalk valleys are thickly lined with beeches; probably they have survived here on account of their sheltered position, the tree falling an easy prey to strong winds, by reason of its shallow roots. In such sheltered valleys the Saxon swineherds of old found ample food for the objects of their care.

In Norbury Park is a well-known beech, reaching a height of 160 feet,—a height equal to twice the depth of the deepest part of the Merstham cutting on the London and Brighton Railway. As beech-trees grow in situations where plant-food is exceedingly scarce, it is important that they should have few rivals; they are therefore enabled practically to monopolise the ground on which they grow, by killing all grasses and other exhausters of the soil, simply by means of their drippings. The White Helleborine is, however, not affected by these, and is frequently in summer the only green thing under the shadow of beech-trees, thus affording a pleasing contrast to the russet-brown of the thick layers of fallen leaves characteristic of every beechwood. Mast from the Beech and Oak zones was an important economic asset in Saxon and Early Norman times, as may be gathered from the frequent mention of "pannage" in Domesday.

Among distinctly calciphobous types may be mentioned the Spanish chestnut (*Castanea vesca*), which, according to Schimper, fails to grow where there is as much as 3 per cent. of lime in the soil ; and the Bracken Fern (*Pteris aquilina*), which is apparently less exacting, for it grows well on Burgh Heath, where chalk is not too far below the surface to assert itself in some measure on the vegetation.

Little need be said of the few hygrophytes found in the water-logged portions of the clayey formations. A list of the most important is appended to this chapter.

The common rush is a sure index to badly drained land, and is most common on the hard, tenacious London Clay in the north-west. It is rarely seen on the usually well-farmed land of the Weald Clay, though on the small unappropriated portion of the once extensive Blindley Heath, its presence shows in a negative way what artificial draining will do.

The Moschatel is especially common in moist places on Gault Clay, and as this formation in the western portion of the sheet is narrow, and in places somewhat difficult to trace, the presence of this little plant may occasionally be some guide as to its limits.

A moisture-loving plant of special interest is the Bog-myrtle (*Myrica gale*), mentioned by Aubrey

as growing in the north-west of Surrey more than two hundred years ago. It seems to have a preference for the Bagshot Beds, which can boast of one other peculiar type—Bent Grass (*Agrostis setacea*). At first sight it seems a little contradictory that the Bog-myrtle should be found on a formation previously stated to support xerophytic types. It must, however, be borne in mind that the Bagshot Beds, like the Lower Greensand, are by no means uniform in texture, but consist at intervals of clays interstratified with sands, and it is on these water-bearing strata that boggy patches occur.

A very cursory mention of some of the many grasses found on the area may find a place here.

The usual cereals—wheat, barley, and oats—thrive well. To these may be added rye, which is cultivated to some extent on the Greensand formations, in order to supplement in summer the scant pasturage for horses and cattle.

Wheat may be seen flourishing in apparently impossible situations on the sides of dry Chalk valleys, especially in the north-east. As a matter of fact, by some farmers, Chalk is preferred to Greensand, for this cereal, as it has the power not only of retaining moisture for a longer period, a few inches below the soil, but it also affords a much firmer roothold for this top-heavy plant.

Among grasses for pasturage, Rough Cocksfoot

(*Dactylis glomerata*) is fairly common on dry calcareous soils. It may be seen growing luxuriantly in the Mole Gap. This is not an indigenous grass, but was introduced from the United States in the eighteenth century. Sheep's Fescue (*Festuca ovina*) is very common on the dry Downs. It differs from most grasses in being unable to assimilate nitrogenous manure. The long-renowned Banstead Down mutton, mentioned by Aubrey as being famous when he wrote his book, may owe its flavour to the sweetness of the Fescue grass.

Red Fescue (*Festuca rubra*) flourishes on the barren soils of uncultivated spots, in the Holmbury and Leith Hill districts. It is a drought-resisting grass, and, by reason of this capacity, often exterminates other more profitable varieties which happen to come in its way. Another drought-resisting variety more worthy of mention is the Crested Dog's-tail (*Cynosurus cristatus*). This grass prefers a compact soil, and is therefore rarely found on Greensand, except where the formation has been well mixed with more tenacious soils.

Among root crops, turnips and mangolds are extensively grown on Chalk and Greensand, on both of which formations it is necessary to supplement the thin crops of grass by every means possible, in order to provide for winter fodder. It

is said that turnips were first introduced into Surrey from the Continent. If this be true, it is probable that the scantiness of the hay-crop in dry seasons was a factor in causing the farmers of this region to be willing to try a new experiment; whilst nearness to the Continent would be a factor no less important.

On many of the farms situated on the Greensand ridge a lime-kiln is found near the homestead. Here chalk from the neighbouring Downs is burned in order to produce lime as a dressing for land poor in this substance, as well as for various other purposes. Very good crops of both turnips and mangolds may be seen in a wet season on Chalk, but where attempted on soils deficient in lime turnips are apt to develop the peculiarity known as "finger-and-toe"; therefore the process of "liming" such soils becomes an absolute necessity for profitable culture.

Trees and other Plants found on Chalk.

Yew (*Taxus baccata*).
Beech (*Fagus sylvatica*).
Box (*Buxus sempervirens*).
Wayfaring-tree (*Viburnum lantana*).
Buckthorn (*Rhamnus catharticus*).
Juniper (*Juniperus communis*).
White-beam (*Pyrus aria*).
Marjoram (*Origanum vulgare*).
Toothwort (*Lathræa squamaria*).
Hemp-weed (*Centaurea scabiosa*).

Milkwort (*Polygala vulgaris*).
Traveller's joy (*Clematis vitalba*).
Deadly Nightshade (*Atropa belladonna*).
Dropwort (*Spiræa filipendula*).
White Helleborine (*Cephalanthera palleus*).
Green Hellebore (*Helleborus viridis*).
Salad Burnet (*Poterium Sanguisorba*).
Bee Orchis (*Ophrys apifera*).
Spotted Orchis (*Orchis maculata*).
Twayblade (*Listera ovata*).
Horseshoe Vetch (*Hippocrépis comosa*).
Viper's Bugloss (*Echium vulgare*).
Yellow-wort (*Chlora perfoliata*).
Rock Rose (*Helianthemum vulgare*).
Blue Chicory (*Cichorium Intybus*).

Hygrophytes.

Oblong Pondweed (*Potamogeton polygonifolius*).
Arrow Head (*Sagittaria sagittifolia*).
Yellow Balsam (*Impatiens fulva*).
Aquatic Bur-reed (*Sparganum ramosum*).
Flowering Rush (*Butomus umbellatus*).
Common Rush (*Juncus effusus*).
Cotton-grass (*Eriophorum polystachion*).
Moschatel (*Adoxa moschatellina*).
Marsh Marigold (*Caltha palustris*).
Sun-dew (*Drosera*).
Lady's Smock (*Cardamine pratensis*).
Purple Loosestrife (*Lythrum salicaria*).
Angelica (*Angelica sylvestris*).
Marsh Violet (*Viola palustris*).
Water Ragwort (*Senecio aquaticus*).
Water-mint (*Mentha hirsuta*).
Water figwort (*Scrophularia aquatica*).
Water St. John's Wort (*Hypericum elodes*).

1. *Wellingtonea gigantea* on Abinger Common.

2. Scots pine on Bagshot Sands at Oxshott (p. 34).

Both pictures show types of vegetation common on sand formations.

CHAPTER IV

ECONOMIC RESOURCES AND INDUSTRIES

As these two considerations are more or less interdependent, it will be convenient to treat them together.

In the early days of industrial activity, it was the minerals of this area which seem to have been the most valuable economic asset. In 1259, stone was quarried at Merstham and Reigate for building the King's Palace at Westminster, and between 1351 and 1356 for works at Windsor Castle. It is said that the Merstham quarries supplied stone for Henry VII.'s Chapel at Westminster. Reigate, besides providing building-stone, seems at a very early date to have done a considerable trade in supplying the neighbourhood with Fullers' Earth.

Digging for iron-ore on an extensive scale cannot lay claim to any great antiquity in Surrey, and probably the sixteenth century was well advanced before any iron-mill was established in our area.

Doubtless the demand in which the Merstham and Reigate stone stood in the clay-covered

region of the London Basin to the north, created a desire for better communications in this part, and eventually led to the establishment of the first authorised public iron railway in England, and probably in the world.

Horsham stone, though used very extensively all over Surrey for paving and for roofing churches and houses of the better sort, does not appear to have been quarried in the part under consideration. As may be gathered from the uses to which it is put, it is of a very fissile nature, and may usually be recognised by its interesting "ripple" marks. Specimens of such ripple-marked stones may be seen on the porch of Mickleham Church, and also on the lych-gate at Betchworth.

There is to-day little demand for building-stone from any of the places mentioned, for it weathers too easily to make it valuable. Chalk is, however, quarried for burning into lime at Dorking, Brockham and Oxted, an impetus having doubtless been given to this industry in recent years by the invasion of suburban population from London.

Dorking lime is of very good quality, as may be judged from its having been used in building the West India and Wapping Docks. Leatherhead is also engaged in the lime trade, and probably in former years, when greater nearness to London meant more than it does to-day, Leatherhead did

a more extensive business in this direction than Dorking, for in its neighbourhood are still several chalk quarries, pointed out as having supplied lime for the rebuilding of London after the Great Fire.

Fullers' Earth is still dug from the Sandgate Beds at Nutfield, though modern methods of cleansing wool and of bleaching calico have threatened the industry with extinction. Curiously, it survives now in a large measure, because the substance has been found valuable for dehydrating cotton-seed and other vegetable oils, which are then fit to be used as adulterants for lard. It is said to be exported to America for this purpose.

Sand is quarried in several places for building purposes, and also for giving better "grip" to locomotives and motor-cars.

The making of bricks is common on all clay formations, more especially on the Weald Clay and Gault, the chief works on the former being at Lingfield, and on the latter at Merstham. An apparently flourishing brickyard on Gault also occurs about a mile due north of Abinger Hall, where one of the best exposures of the formation may be examined. Bricks appear to have been in use over the area in frameworks of timber from the fifteenth century, one of the best examples of this type of building being at Lingfield.

Drain-pipes and other coarse pottery are made at Epsom, Leatherhead, Dorking, Godstone, Redhill and Crowhurst, the first two of which are on or near the Woolwich Beds (*l'argile plastique* of France) ; the next three overlook the Gault Clay, and the last is on the Weald Clay.

Iron-ore for smelting seems to have been dug from three distinct deposits : (1) from the sand of the Hastings Bed in the Lingfield area ; (2) from the Weald Clay which supplied the Charlwood, Newdigate, and Leigh mills, mentioned in the reign of Elizabeth as having belonged to Christopher Darrel ; (3) from the Lower Greensand Beds, for the supply of the mills in the Tillingbourne Valley. Probably the ferruginous bands known as "carstone" in the Folkestone Beds supplied the necessary ore to the last mentioned.

In each of the above areas, there survives a name which perpetuates the memory of this industry—namely, Forge Pond, at Lingfield ; Hammer Bridge, on the Mole above Leigh, with Irons Bottom in the same district ; and Abinger Hammer in the Tillingbourne Valley.

Surrey was late in developing her iron industries, chiefly because of the badness of the roads over the Weald Clay. We know that in the latter half of the sixteenth century the work was well established, for in the year 1581 the first of a series of

1. Fuel stacked for winter use in the Tillingbourne Valley (p. 69).

2. Appearance of wood near Holmbury after the spring clearing. The oak-trees have been stripped of their bark for tanning purposes (p. 37).

prohibitive measures designed to check the destruction of forests was passed, making exemption of the woods of "Christopher Darrel, gentleman, in the parish of Newdigate, within the weald of the countie of Surrie which woods of the said Christopher have heeretofore beene, and be by him preserved and coppised for the use of his iron-works in these parts."

With regard to the neighbouring county of Sussex, there is documentary evidence that the industry flourished as early as 1266. Probably the circumstance which afterwards made it a profitable industry across the Sussex border, was the increasing desire for iron ordnance during Elizabeth's reign. However this may be, during the next seven years the industry had developed so alarmingly in Surrey that in 1588 Lord Howard of Effingham, Lord-Lieutenant of the county, was enjoined "to appoint a discreet gentleman to visit the iron furnaces and forges of the county, to ascertain the number of pieces of ordnance lying ready in them, and to enjoin owners and foremen not to cast any more until express direction should be received from the Council."

The development of the industry had profitable side-issues in opening up the Weald Clay areas for further settlement, and in calling public attention to the condition of the roads, as we see from

Act 27 Eliz., cap. 19, entitled "An Act for the preservation of tymber in the Wildes of the Counties of Sussex, Surrey and Kent and for the Amendment of the High Waies decaied by carriage to and fro Iron Mylles there." The terms in which the enactment is couched, show that the carriage of goods over the Weald was practically limited to the summer months, for it stipulated that "for every ton of iron and every six loads of coals (charcoal) carried *one mile* through any of the highways under the North Downs of Surrey and Kent, between the 12th October and 1st of May in every year, the occupiers of the iron-works should carry one load of gravel or stone, sand or chalk for repair of these roads, or in lieu thereof pay three shillings and six pence for every load."

This measure indirectly throws light on the somewhat primitive methods adopted for making or mending the roads of the period.

In spite of prohibitive measures, the iron industry continued to flourish until the middle of the seventeenth century, when it seems to have reached its highest development. Even when the method of smelting iron with coal became widely known, the industry continued to smoulder on, and was not finally extinguished until well on in the eighteenth century.

Besides ordnance, including both guns and gunshot, the articles made were fire-backs, of which there are several good instances in the neighbourhood ; grave slabs, of which the only example in Surrey is in Crowhurst Church, and *may* have been forged in Sussex ; door-scrapers, for which there was a special need in the Weald ; and many other things in common everyday use.

The special circumstances which attracted the manufacture so far north as Abinger, were probably abundant water-power, supplied by the little River Tillingbourne, and nearness to London. The last was a factor of added importance when we consider the condition of the roads to the South. The succession of "hammer" ponds, which were found necessary in those days for impounding water, still testify to precautions taken in the Tillingbourne Valley against a dry season.

Almost simultaneous with the extension of iron-smelting over the Sussex border was a desire for a stronger navy. It was doubtless this fact which drew public attention to the steadily decreasing supplies of oak timber in the iron-smelting districts, and thus caused the prohibitive measures above referred to.

The Government Dockyards were at Deptford, just where the Ravensbourne enters the Thames

It was of vital importance, therefore, that oak forests on the southern side of the river should not be wantonly destroyed.

Evelyn, in the introduction to his "Sylva" (1662), joins in the general lament over the alarming diminution in the supplies of oak timber. "Trees have diminished," he says, "not only by increased number of ships that have been built, but also by reason of multiplication of glass-works, iron-furnaces, etc." He is here silent, probably for private and personal reasons, about another industry—that of gunpowder-making—which his family had first introduced from the Continent into Surrey. Nevertheless, in a letter written by him, and prefixed to Aubrey's "History of Surrey," he says: "Not far from my brother's house [at Wotton], upon the streams and ponds since filled up and drained, stood many powder-mills, erected by my ancestors, who were the very first who brought that invention into England, before which we had all our powder out of Flanders."

It must not be inferred from the above that the powder-mills themselves stood at Wotton. Probably the earliest mills in the area with which we are now concerned, were built at Godstone in 1613. Later, this industry also seems to have been transferred to the Tillingbourne Valley, probably for

the reasons which attracted the iron trade thither. The industry is interesting as furnishing an example of one of the monopolies put down by the Long Parliament in 1640. The Evelyns had severed their connection with it four years before this date.

There is little doubt that the inroads made upon the oak forests in the half-century before "Sylva" was written, were far greater than those complained of in Elizabeth's time, for the charcoal-burning industry was probably never more flourishing than during the Early Stuart period, when the nation had become alive to its unpreparedness for war.

Thus the old Wealden Forest, which had in its lifetime *passively* protected the southern approaches to the capital, became, in the period of its destruction, by virtue of its providing ships for the navy, guns and gunpowder for the army, an *active* instrument in providing security.

When we consider the geographical position of our area at the beginning of the Civil War, midway between two out of the three existing arsenals of the kingdom—namely, Portsmouth and the Tower of London—added to the fact that the iron ordnance and gunpowder trades flourished here side by side, we realise how great was its strategic importance at that time.

Among other industries largely determined by the abundance of oak forests was the tanning of leather. It was easier to carry the skins to the oak-bark than *vice versa*, and the industry very likely developed in proportion as the trees were cut down for the various purposes mentioned above. Numerous place-names derived from this source are indisputable evidence that the industry was a well-established one. Examples of such names are Tanners' Brook, Tanners' Hatch, Tanhurst, Tanhouse Farm, and Tanners' Bridge.

Judging from the position of the foregoing, side by side with that of the places reputed to have been engaged in the industry, tanning seems to have been followed over a widespread area. As would be expected, the places group themselves on the three oak-belts already mentioned. On or near the North-Western belt are Bookham, Stoke d'Abernon, and Leatherhead ; overlooking the Gault Vale are Reigate, Godstone, Oxted, and Blechingley ; and on the Weald Clay are Lingfield and Horley. The proximity of lime in the Chalk belt probably accounts for the industry having been more extensively practised on the two more northerly Clay belts than on the Weald Clay, lime being formerly a necessity for "unhairing" the skins and for softening the leather. The industry

has survived in Redhill, where there is to-day a large tannery.

Many hands are employed in collecting and dressing road-metal for the various districts. There is little need in the Clay-with-flint areas to quarry for this purpose, for apparently inexhaustible supplies of flints are every spring turned up by the plough, and afterwards picked from the fields by women and children. The flints are often of very large size, weighing fourteen pounds or more. They must therefore be broken up into smaller pieces, and because they are then too brittle to be used immediately for road-mending, they are spread out in tabular heaps to toughen by exposure to the air. Since motor traffic called for improved roads, many districts are discontinuing the use of so much local material, and are using instead small angular pieces of Norwegian granite. This has been proved in many districts to make the best macadamised roads. The bands of ironstone previously referred to as being found in the Folkestone Beds are also used locally for road-mending, probably thus earning their name of "car-stone."

Car-stone is likewise used in almost every village for a system of paving known as "iron-pitching," and also for "garnet-jointing," as it is locally called (Plate VIII.). The latter

process is one apparently peculiar to Surrey. Although it appears to have originated from a desire to prevent the mortar from weathering too readily, yet it is not without a certain degree of decorative value, and is for that reason often introduced with effect into modern buildings.

Hitherto, no prominence has been given to agricultural and pastoral pursuits, which must have been followed from very early times, and which probably developed in proportion as the foregoing industries became better established.

The Wealden and Gault Clay areas were better adapted to wheat-growing than any of the other formations, and if one may draw conclusions from the substantially-built farmhouses and barns over these and other portions of our area, the Surrey farmers were probably among the most prosperous in the kingdom. From sheep-rearing alone little fortunes appear to have been made. We learn from Aubrey that the parsonage at Shere was "built on wool."* It was partly the superiority of English wool which brought this part of Surrey at an early date into trading relations with the Continent, especially with Flanders, and it may be quite fairly assumed that the Stoke d'Abernon brass, which is the very earliest in the whole

* *Cf.* "Such stuff as dreams are made on" ("Tempest," Act IV., Scene 1).

1. "Garnet" jointing in a wall at Coldharbour (p. 59).

2. Deep well in chalk. The legend on well-head reflects feelings of men towards older methods of raising water (p. 99).

of England (1277), and is generally recognised as of Flemish make, may have found its way here as return cargo in a boat the outward cargo of which was wool. Stoke d'Abernon is only five miles as the crow flies from the Thames at Long Ditton, and it therefore was in early days one of the most accessible places in this part of Surrey.

THE BRASS TO SIR JOHN D'ABERNON, SHOWING THE CHAIN ARMOUR WORN BETWEEN 1250 AND 1300 A.D.

From "What to See in England," by Gordon Home.

Nor can the attention of the early flock-masters have been concentrated on producing good wool alone, for Aubrey speaks of the excellence of Banstead mutton. To-day the flocks have been withdrawn from many of the northern valleys, as may be inferred from the survival of a disused shepherd's cottage here and there; some of the farmhouses are turned into workmen's cottages, others have as sole occupants the owl and the bat; whilst

on the once well-tilled ground surrounding them the tall ragwort now rears its proud head. These changes afford striking evidence of the agricultural depression, which has affected this part of Surrey, in common with other parts of England.

There are dry valleys in the area round Coulsdon, where other considerations have operated to drive the sheep from their pastures, and smaller animals, such as stoats and rabbits, from their respective haunts. Nevertheless, large flocks of sheep are profitably kept on the Downs to-day, and it is consoling to think that flock-masters from our area are even now in the habit of meeting at Guildford in July for their annual wool sale. Stoat's Nest Farm *—a deserted and dilapidated group of buildings in Smitham Bottom—must have been once in the occupation of sheep-owners, for about a mile farther up the valley Shepherd's Cottage (Map IV.), an old, heavily thatched tenement, stands in striking contrast to the modern red-tiled villas characteristic of suburban London. The stoats and their prey have betaken themselves to more secluded valleys; the farm and the conditions which gave rise to its name, are almost forgotten; and though there is something incongruous about the transference of that name

* This farm has been pulled down since the above was written.

to a neighbouring railway-station, yet it is just this which will save it and the conditions from complete oblivion.

Among industries still carried on in the forested areas are wood-cutting, hurdle-making, preparing hoops for sugar-barrels, and charcoal-burning.

Charcoal from the area near Abinger still finds its way to the London market, and the hoops for sugar-barrels are exported to countries producing cane-sugar. Some feeble attempts have been made at afforestation, chiefly on the chalk formations north-west of Abinger. If it were followed in this country more assiduously, there would be little need for us to import from France garden-palings already wired together, such as are seen in use near the suburban villas previously mentioned, for the young trees thinned out from the plantations could be split up for this and similar purposes.

The depressed condition of agriculture has led, especially near the suburban districts, to a variety of experiments, such as fruit and poultry farming, in order to supplement slender incomes. In almost every case the land formerly devoted to wheat-growing has been reduced in area, and given up to the growth of something which generally involves less labour.

Thus in many districts farmers are giving atten-

tion to the production of milk, which in the thickly populated areas brings in a quick and steady return, and, besides, has the advantage of not being in danger from foreign competition. As this trade involves a good supply of winter keep, we find here an additional reason for the unusually large acreage devoted to root-crops.

With regard to poultry-rearing, it may be remarked that the "Surrey" fowls are in great demand in London, and that Dorking has earned a world-wide reputation for a special breed. This circumstance may be in a great measure due to the abundance of limestone in the district.

Near Woodmansterne is a farm having a considerable acreage under peppermint and lavender, whilst near Oxted hops are cultivated with apparent success. Lingfield and other places possess oast-houses, which speak of a time when hop-growing could be carried on successfully on a more extensive scale, though recent developments in the brewing of beer have nearly put an end to this industry—at least, so far as Surrey is concerned.

Near the site where formerly stood the Abinger Hammer iron-mills in the Tillingbourne Valley, an apparently flourishing occupation to-day is that of cultivating watercress for the London market. The presence of ironstone in the Greensand Beds doubtless contributes to the success of this industry.

1. Farm in the Mole Gap. Rat-proof supports under the barn are plainly seen.

2. Well-house thatched with wood-shavings capped by heather at Holmbury St. Mary.

CHAPTER V

COMMUNICATIONS

In the early days, before wheeled vehicles came into common use, the roads were mere cattle-tracks or drove roads. In fact, there is little doubt but that the drove roads on the Downs date back to prehistoric times, for Neolithic man has left behind him on the high ridges of the Chalk and Greensand, flint implements which testify to his having once lived and worked there. It is difficult to realise that the luxury of good roads is a comparatively recent one, and that even in Cobbett's time (1822) the Weald had "lanes of bottomless clay."*

Some of these lanes to-day may be found bordered by miles of stone causeway, especially in the neighbourhood of Horley and Gatwick; and this in a country naturally deficient of good

* In his "Rural Rides," Cobbett describes how he rode from Ewhurst towards Dorking: "From Ewhurst the first three miles was the deepest clay that I ever saw. . . . It took me, however, a good hour and a half to get along these three miles. Now, mind, this is the real Weald, where the clay is bottomless."

stone, is strong testimony as to the former badness of the roads. If additional testimony be needed, it may be had from the abnormal size and strength of the iron scrapers which are to be found over this area, especially at some of the church doors. Birch brooms firmly fixed on posts placed in the ground are still considered necessary adjuncts to many houses built on the Weald Clay (Plate X.).

A good example of an ancient road is the old drove road between Guildford and Dorking. It can be followed on this sheet from a point due north of Abinger Hall to the latter town. As it rests on a firm basis of chalk, it is superior to many roads of the same period over formations of a softer nature. This fact probably partly explains why it has survived the competition of newly metalled roads, though it is to-day only used by gipsies, wood-cutters, charcoal-burners, and the like.

Another road of the same description runs from Smitham Bottom up to the top of Farthing Downs, where it continues on a kind of hog's-back ridge, until it gradually merges into a second-rate road running by Chaldon Church and a succession of farmsteads, after which, descending over the escarpment, it continues southwards towards Nutfield. These two old roads consist really of a number of tracks extending sometimes over a

breadth of forty or fifty yards or more. There was unlimited space in the early days of road-making, and no sooner were the tracks deep and worn in one part, than wayfarers betook themselves to another.

Among the oldest roads should also be mentioned *Stane Street*, of which little trace can now be found. This was part of a Roman road from Chichester to London. It enters our area a little more than a mile due south of Anstiebury Camp, and, avoiding the Weald Clay, keeps on sandy formations nearly all the way to Dorking, north of which it probably was continued through the Mole by a ford near Burford Bridge, and then by Mickleham Church into what is marked on the map as Ermyn Street (Map VI.). The latter is in reality a narrow lane or bridle-path, continuing from Mickleham Church towards Ashtead Park.

In some parts of the sheet it is possible to trace the supposed Pilgrims' Way, the course of which is usually bordered by dark lines of yew-trees. The exact position of this historic route is difficult to decide. It seems to extend along the Downs north of Abinger, as far as Dorking, after which it reappears in Gatton Park, but is lost again at Redhill. It can next be traced on White Hill, east of Merstham.

The Weald Forest was an obstacle to be reckoned with by the early road-makers. They therefore avoided it, and this, together with the fact that the almost " bottomless " Weald Clay was difficult to negotiate, explains why the southern half of the sheet was so late compared with the northern half in being developed. The villages in the northern half, farther away in actual miles from the refining influence of contact with the Continent, reached a stage of development in Saxon and Norman times which was withheld from the villages farther south. Stoke d'Abernon, with its Norman architecture and old monumental brass, is an example of this. The early settlers probably found their way up the Thames Valley, and gradually spread southwards over the Chalk Downs.

Some trace of isolation in the more remote Wealden villages can still be detected in the lingering superstitions, peculiar speech and habits of the people, though railways have done much to remove linguistic and other peculiarities.

Perhaps the least advanced people in the whole area are those living in the deeply furrowed region north of Leith Hill. One is astonished to find here people to whom the luxury of a coal-fire is unknown. They are free to take as much wood as they can carry themselves from the neighbour-

ing coppice-land, and one may see in spring the women and children of these little communities busily carrying the faggots home. These they stack up for winter use, near the homestead (Plate VII.).

Among the earlier roads designed for vehicular traffic are the old Portsmouth and Brighton Roads. The modern representative of the former runs across the north-west corner of the sheet, entering near Epsom, and leaving a mile to the south-west of Effingham. It will be noticed that this road runs about half a mile or so, to the south-east of Fetcham, Great and Little Bookham, and Effingham villages, thus making it necessary for a parallel road to link up these places. A glance at the geological map (No. I.) will show that the said villages are grouped on the Woolwich Beds. As this formation was less well adapted to road-making than the more compact chalk, the makers of the Portsmouth Road usually avoided it. This is particularly well shown in the section west of Leatherhead, where there are two curves convex to the south, which almost exactly correspond to similar curves of clay in the Woolwich Beds.

The Brighton Road enters the sheet about one mile north-west of Banstead. It does not strike in a straight line towards the Gap at Reigate for two reasons : first, by doing so it would have to

cross two of the east-to-west dry valleys, already mentioned as belonging to the Chipstead system; and, secondly, the sandy formations overlying the chalk near this point probably ensured a better grip in wet weather than the chalk itself; hence the curve convex to the west, over Burgh Heath. In support of the latter theory, the said heath is riddled with sand-pits, from which, on good testimony, sand was dug for mending the roads until fairly recently, when modern developments in locomotion began to demand something better.

Near Tadworth this road bifurcates, one branch making for the Reigate Gap and the other for Pebblecombe Gap. Of these, the Reigate Road is the more popular, for of late years its gradients down Reigate Hill have been carefully modified, whilst those of the rival gap are left very much in their natural condition. The name "Bridlecombe Barn," not half a mile from the Pebblecombe Road, probably points to a time when the road was a mere bridle-path.

The other road to Brighton proceeds from Croydon, through Smitham Bottom, up the deserted valley of the Merstham stream. It does not invariably follow the course of the old Brighton Road, portions of which are still to be traced 200 yards or so to the west of the present road. A well-engineered embankment, rising in places

to ten feet or more above the general level of the valley, regulates its ascent from Coulsdon southwards. Near the northern entrance of the railway tunnels marked on Map I., it makes a succession of zigzags until a summit level of 440 feet above sea-level is reached about a mile above Merstham, from which place it descends towards Redhill in a direction roughly parallel with a fault-line shown in Map I.

Modern developments at Redhill, caused by the main Brighton line passing through that town rather than through Reigate, two miles to the west, probably explain why parallel roads to Brighton only two miles apart should be necessary in this district.

Other well-metalled roads of this type are the road from Kingston to Worthing, passing through the Mole Gap and over the eastern edge of the Sandstone ridge near Holmwood ; the Eastbourne Road, passing by the foot of Riddlesdown, and descending the escarpment by the Caterham Gap ; and the Sevenoaks Road, which cuts off a triangular piece from the north-east of the map, as the Portsmouth Road does from the north-west. It will be observed that all of these roads converge on London towards their northern extremities, and for that reason are among the most important in the county. The chief east-to-west route is one

which must have existed from very early times, linking up as it does the various Gap towns on the south of the Chalk escarpment. Its being placed at a distance of about one mile from the foot of the Downs can be explained by the fact that it runs for the most part along the northern edge of the Sandstone ridge, for the intervening Gault Clay is very difficult to traverse. It is part of the route from Guildford to Maidstone, and enters the sheet a little to the west of Abinger Hall. Dorking, Reigate, and Redhill are passed without any serious gradients being encountered. However, east of Redhill Station it climbs Redstone Hill by a series of zigzags until a height of 543 feet is reached, between Nutfield and Blechingley, from which point a splendid view of the escarpment to the north, with the intervening Gault Vale, can be obtained. The road then descends to Godstone village, and leaves the sheet about one mile east of Oxted.

RAILWAYS. This sheet is of unusual interest, as possessing portions of the first authorised public iron railway in England. The Surrey Iron Railway from Wandsworth to Croydon had been built in 1801, and in 1803 royal assent was given to the Croydon, Merstham, and Godstone Railway, which was a continuation of the earlier one. The

engineers chosen appear to have been Jessop and Outram, both of whom had been engaged in constructing a system of rails connected with the coal-mines in Derbyshire. It is unfortunate that in the area under consideration the rails of this old tramway have all been torn up. It appears, however, that they were double throughout. They were merely lengths of cast-iron, three feet long and four and a half inches broad, with one edge turned up to form a flange, whilst the wheels themselves were plain.

In the absence of any good photograph of the Surrey Iron Railway, others of a possible prototype in Derbyshire, also designed by Outram, have been inserted, as showing an interesting link in the evolution of railways (Plates XI. and XII.).

Promoters of these new methods of traction stood in perpetual fear of having sections of their permanent way torn up by owners of rival conveyances. This method of retaliation seems to have been of common occurrence in Surrey, where, in the absence of any really durable stone, sleepers of wood were probably adopted. The Derbyshire prototype is laid on such substantial blocks of Millstone Grit that it would be a difficult and costly matter, even now, to remove all trace of the line.

The necessary power for these early railways

seems to have been supplied by horses, mules, and donkeys; and though the scheme in Surrey was a financial failure, and was never finished beyond Merstham, it demonstrated unmistakably that friction could be considerably lessened by running wheels over a perfectly smooth and regular surface. The track of the Surrey Railway is practically undisturbed in that portion of the Merstham Gap which covers the tunnels. A few yards from the northern end of these, there still exists a small bridge of bricks, little calculated to carry the heavy vehicles of the twentieth century, as the notice affixed to it intimates (Plate XII.). Of the three bridges crossing the old railway, this one alone carries a road of any importance—namely, that from Chipstead to Chaldon and Caterham. The joints between the bricks support an abundant crop of rue fern; whilst underneath may be seen trails of ivy. How unlike the smoke-begrimed arches which afford passage to the locomotives a few yards away!

With regard to modern railways, it is noteworthy that the chief lines run in the direction of the more important roads—that is, from north to south, from east to west, or diagonally across the north-east and north-west corners respectively. This shows how little modern engineering skill

has added to the knowledge of our forefathers in the mere choice of route.

Of the north-to-south routes, the one through the Merstham Gap must be given the first place, though this at first strikes one as an anomaly, seeing that the Mole Gap, considered by itself, offers an easier passage. In railway-making, however, as in other matters, initial cost is not always the first thing to be considered, and promoters of the London and Brighton Railway did well to carry their main line by Redhill rather than by the Mole Gap, thus shortening the mileage considerably, without seriously increasing the gradients.

This line was sanctioned in 1837, and opened in 1841. So far as the present sheet is concerned, the only physical obstacles encountered were the Chalk Downs and the Weald Clay—the latter much more subtle, and therefore more difficult to cope with, than the former. The Downs were pierced first by an open cutting eighty feet deep in its lowest part—a depth more easily appreciated by looking downwards from the top, than upwards from the train as one passes quickly through. Next comes a tunnel 1,830 yards in length, followed by a second deep cutting towards the south.

As stated before, the summit level above the

tunnel is 440 feet, that of the railway is 310 feet ; thus by boring through the hill an ascent of 130 feet is saved.

The second obstacle was encountered south of Redhill, near Earlswood Common, where the boggy Weald Clay required tons of earth to be deposited over it before it " settled " sufficiently to carry the railway successfully across. An embankment forty-five feet high, and extending for a considerable distance south of Earlswood Station, gives some idea of the unlooked-for expense entailed in this part of the line.

The other north-to-south railways on the sheet are the London, Brighton, and South Coast branch line from Leatherhead to Dorking, and thence to Horsham, and the South-Eastern and Chatham Railway from Croydon to Redhill. So far as this sheet is concerned, the latter is continued from Redhill to about two miles east of Godstone as an east-to-west route. The branch from Leatherhead to Horsham runs through the Mole Gap. Its convex loop towards the east, between Dorking and Holmwood, is probably to avoid a longer tunnel through the Sandstone ridge. It has to make a tunnel even in the Mole Gap, for just north of Mickleham Church, the valley narrows so much that the railway had no choice but to make a sharp curve, such as is made

by the road and the river, or tunnel the spur of chalk around which the valley sweeps. By choosing the latter alternative, a high speed can be maintained throughout this part of the route.

The other east-to-west route is the Reading and Reigate branch of the South-Eastern and Chatham Railway, running from Reigate along the Gault Vale, towards Dorking and Gomshall.

The lines mentioned as passing diagonally across the northern corners are the Croydon, Oxted, and East Grinstead branch of the London, Brighton, and South Coast Railway, the South-Eastern and Chatham Joint Railway in the north-east, and the Claygate and Effingham Junction branch of the London and South-Western Railway in the north-west. Much of the last-mentioned is on the London Clay Beds. It has, therefore, to be provided with specially constructed banks wherever a cutting is made, for London Clay is given to "slipping," if not treated with special caution. For the same reason this is the case both with the small branch running from Effingham Junction to Leatherhead, and with that from Epsom to Leatherhead.

Other railways of minor importance are the Chipstead Valley Line to Tattenham Corner and the Caterham branch along Caterham Valley. It will thus be seen that the northern half is much

better served with railways than the southern, the northern boundary being entered by *seven* different railways, whilst only *two* leave it on the south. It will not be surprising, therefore, when we come to deal with the distribution of villages and of population generally, to find that there is a considerable area south of Dorking, Reigate, and Redhill very sparsely populated, this condition being, perhaps, as much a cause as a result of the poor railway service.

CHAPTER VI

PLACE-NAMES

As an examination of the place-names of any area often throws light on the tribes occupying that area at successive periods, as well as on their civil and religious institutions, it may be profitable to examine some of the village and farm names on this sheet. In doing so, however, generalities only will be dealt with, as a detailed explanation of place-name derivations is quite outside the scope of this book.

It is evident from the great preponderance of names introduced by the Saxons, how complete must have been their conquest of Surrey. The Celtic element, as might be expected, is extremely difficult to find. *Combe,* meaning a cup-like depression in a hill-side, has survived in Pebblecombe, Bridlecombe, and other words. The Welsh *cwm* is a variant of this word.

Among Saxon endings, some, such as *ham, stead, ton,* and *worth,* have meanings implying a " home " or inhabited settlement of some kind ; whilst

others, such as *hurst*, *fold*, *field*, and *ley*, refer to things natural, and are such as one would expect to find in a forested area such as in early Saxon times extended over the Weald. It is a significant coincidence that out of eighteen terminations in *ham*, only one occurs in the forested area over the Weald, and, of the seven in *stead*, all are in the northern or non-forested area.

Also, out of eight names in *ton*, seven are in the northern area, Wotton being the only exception in the south; and out of four in *worth*, only Cudworth is in the south.

In the case of terminations of the second type, there are altogether the unusually large number of twenty-two places ending in *hurst*, only two of which are in the north. These *may* be later imitations; the compound form *Walton Hurst* almost certainly is so. Nine out of ten instances of places ending in *field*, and the only two in *fold*, are in the forested area of the south.

In the above analysis the proponderance of names in a given area is too great and the multiplicity of places too striking to be mere coincidences, and we must therefore look for an explanation. The Saxons who settled in Surrey probably entered it from the north, having found their way thither by the Thames. They built their *hams* and *tuns* in the Thames Valley at

1. Birch-broom fixed in pavement. Such brooms are common on all clay formations.

2. Toothed millstone and sarsen stones at Gomshall (pp. 92, 11).

first, and, as time went on, gradually spread out southwards. Thus, we find that whilst the northern boundary-line of the map bisects four parishes with names ending in *ton*, a line can be drawn from east to west through the middle, without touching any such parish; whilst south of this medial line there is only one instance—shortly to be accounted for.

We will now proceed to examine in more detail the various terminations given above, taking first those found north of the Chalk escarpment:

Ham, according to Professor Skeat, arises from two distinct Anglo-Saxon roots. The first of these (*hăm*) means an enclosure or place *hemmed* in; the other (*hām*) is the original of the modern English *home*, meaning a village or village community. As it is now often very difficult to trace names of this type to their respective sources, they may be dealt with together.

Now, as all the terminations of this class in our area, with the one exception of Wonham, are in the non-forested area, may we not, in the absence of other evidence, reasonably surmise that *ham* in this one case meant an enclosure simply? It would then have a similar meaning to many of the other terminations on the forested area.

Ton, or *tun*, was used originally in a much more

restricted sense than it is at present, meaning only a single enclosure round a homestead or farm, or often the *home* itself, which meaning it retained until Wyclif's time,* and even to the present day in some parts of Scotland.

As the names in *ton* and *ing* are most numerous in the area to the north of the one under consideration, and gradually decrease as one goes southwards, we may take this as strong evidence that the Saxons invaded Surrey from the north, and did not in very early times plant villages south of the Chalk escarpment. In fact, only one instance of *ton* is found south of the Chalk. This is *Wotton*, about two miles to the west of Dorking. Like the Dorkingas, the early settlers of Wotton must have found an easy way through the Mole Gap. The name of this place is interesting, for hitherto, people had avoided venturing into the forest precincts, and the first who did so very naturally called their home *Wood-town*.

Worth was applied to an enclosed homestead or farm (Skeat).

Ing belongs to quite a different type from those quoted above, being a Saxon patronymic, similar

* In "Old Mortality," chap. iii., Scott uses the word *town* for the home itself, with a footnote explanation to this effect: The Scots retain the use of the word *town* in its comprehensive Saxon meaning *as a place of habitation*. A mansion or farmhouse, though solitary, is called "the town."

to what we see in the word "Athel*ing*," the Scotch "*Mac*donald," or the Welsh "*Ap*thomas."

Out of twelve words compounded with *ing*, only three appear south of the Chalk escarpment; and each of these is on or near a "gap" in the Chalk. The Mole Gap apparently offered an irresistible passage to the Dorkingas, or people who first occupied Dorking, as well as to those who gave their name to the Tillingbourne. It is probable that the Blechings left the higher ground either by the Caterham Gap or by the "Ridge Gate," for their home, Blechingley, lies between the two. The "Tillings" seem to be the only family who decided to live far apart—one section giving their name to "Tillingdown," in the east of the Chalk ridge, and the other, as we have just seen, to the Tillingbourne. The former would be men of the hills, of a conservative temperament, and content to stay at home with their flocks. The latter would represent the more progressive type, and were probably herdsmen, as the luscious green pastures of the vale in which they settled were more suited to cattle than to sheep.

Many names connected with various plants have already been dealt with, because they supported statements made about the vegetation zones. There is, however, one left for consideration here.

Furzefield is of frequent occurrence as the name

of a single field, and is generally found near a lime-kiln. Furze faggots were invaluable for kindling the fires which burnt the lime, hence the precautions taken to grow a plentiful supply in close proximity to the farm lime-kiln. Nor was the use of the furze faggot confined to this purpose. In a district quite destitute of coal and badly supplied with roads, coal-fires found their way into farm-houses comparatively late, and the use of large brick ovens survived until recent times. For heating the latter, the furze faggot had no equal.

Some places obviously owe their names either to the geological formation on which they happen to be situated, or to some topographical feature in the neighbourhood. Redstone Hill has been contracted into Redhill, from the colour of the Greensand at this place. Clay Hall Farm, south of Reigate Park, and Clay Hill Farm, south of Leigh, are both on Weald Clay. Reigate, Ridge Green, Broadridge, and Tandridge, have presumably all reference to one or other of the ridges running east and west.

Among names referring to the animal kingdom are Brockham, Bagden, Hogden, and Pigdon.

Brockham and Brockhamhurst are derived from *brock*, the proper name of the animal now known as the *badger*. Shakespeare uses this name in

1. One of Outram's railways at Little Eaton, in Derbyshire, showing sleepers of millstone grit (p. 73).

2. Primitive waggons with detachable tops. The waggons are seen to be the same as in Plate XII. (p. 73).

"Twelfth Night" (ii. 5). The name *badger* is a nickname, originally spelt *bageard*, and applied to this animal because it was supposed to steal corn (Modern English, *badger*, *bager*, a dealer in corn). The French *blaireau*, from *blé*, corn, is an interesting equivalent. This has been dealt with thus fully because the two pairs of words *Bagshot* and *Bagden*, *Brockham* and *Brockhamhurst*, probably refer to one and the same animal.

A *den* was a deep wooded valley in which swine were often kept, because of the beech-trees which found shelter there. Bagden Farm (Map IV.) is seen from the contour lines to be in such a position on the Chalk Downs. Polesden is a little higher up the same valley. Pigdon* and Hogden are in a tributary valley.

It is an interesting and corroborative coincidence that of the four places thus dealt with, Bagden approaches most closely to the River Mole, the valley of which is known to be even now a favourite haunt of the badger and its relative the otter.

* *Don* here is almost certainly a corruption of *den*, the latter being justified by geographical position as well as by combination with a suitable prefix.

CHAPTER VII

POSITION OF FARMS, VILLAGES, AND TOWNS

Some very interesting cases of what Mr. Mackinder has called *nodality* occur in this area with regard both to villages and farms; and since in an agricultural district a farmstead often forms a nucleus round which a town gathers, the position of farms will be considered first.

In the system of valleys so deeply entrenched in the Chalk to the south of Croydon, it is impossible to walk far without arriving at a place where two or more valleys converge. Running along the bottom of each valley is a road or pathway, according to the size and importance of the valley. It is not difficult to see, even in these peaceful days, why the farmer has his headquarters at the convergence of two such roads or pathways; and when we consider that in days gone by he had to keep off marauders as best he might, we see how important a good strategic position was to him. Probably in the very early days of settlement the more secluded valleys were used only as Mark-land between two parishes; but as the population

increased and became more civilised, these Marklands would be gradually appropriated by the nearest parish.

A few only of the farms found near converging valleys need be mentioned. Of these, Warren Barn, marked in the north-east quarter of Map IV., is a good example. It commands the pastures lining two well-marked dry valleys stretching towards the Chalk escarpment, as well as those of a minor valley towards the east.

Bug Hill Farm, lower down the same valley, is even a better instance of nodality, for it stands at the convergence of this valley with that now occupied by the Croydon, Oxted, and East Grinstead Railway. Stoat's Nest Farm, in Smitham Bottom, commanded the roads up three converging valleys, which, like those previously mentioned, have been long abandoned by the streams to which they owe their existence.

The south-west corner of the sheet furnishes similar examples, of which Broadmoor Farm is perhaps one of the most typical. The converging ways at Broadmoor differ materially from those above described, for, being on a different formation, each valley is occupied by a tiny streamlet, the larger of which is the Tillingbourne.

This nodal point has, moreover, reached a more advanced stage of development; for the farm has

collected around it several small cottages, the whole forming the old-world hamlet of Broadmoor. Scores of pedestrians now pass through this hamlet in the summer-time, as there are radiating from it two pathways leading respectively to Leith Hill and Friday Street. Its nodal position may thus in the near future acquire an added importance; for tourists walking from Dorking or Westcott to Friday Street find Broadmoor a convenient halfway house for rest and refreshment; and though some of the cottagers offer shelter from the noonday heat under the fruit-trees in their gardens, there is not yet sufficient accommodation for the ever-increasing number who pass this way.

Larger places showing marked nodality are Reigate, Redhill, Leatherhead, Dorking, Betchworth, Nutfield, Blechingley and Godstone. Of these, it might appear, from a consideration of relief alone, that Leatherhead and Dorking had unrivalled positions, since the River Mole has opened a natural route for travellers between London and the south coast. The fate of these two places was, however, sealed when the main line to Brighton was chosen through the Merstham Gap, and hence we find that, whilst Leatherhead and Dorking have advanced but slowly, Reigate and Redhill, with their excellent service of trains,

have extended their former limits beyond all expectation.

The following table speaks for itself:

	Population in 1833.	1901.
Reigate	1,633	25,993
Redhill	—	15,732
Dorking	3,812	7,670
Leatherhead	1,478	4,694
Horley	1,063	3,669

During the latter part of the old coaching days, Dorking enjoyed a position second to none in the whole area. In those days a population of 3,812 in this part of England was regarded as considerable. We are, therefore, somewhat surprised to find that nearly three-quarters of a century later it had but just doubled. We seek an explanation for this in the changed economic conditions which have affected so many places in this district, as well as in the new methods of locomotion and improved engineering skill, which by making possible an artificial road of steel through the Chalk escarpment at Merstham, have diverted the traffic eastwards.

Dorking is interesting as being an instance of what may be called *arrested development* from the causes just given. Its fine position at the entrance of the Mole Gap was recognised even in Roman times, for not only did Ermyn Street approach it

from the north, but Stane Street, already alluded to in the chapter on Communications, connected it with Ockley and Chichester to the south. An east-to-west road along the Downs must have given easy communication towards Maidstone and Canterbury on the one hand, and Guildford on the other at a very early date.

Both Dorking and Leatherhead acquired a certain importance in early coaching days from the fact that they were almost due south of Kingston, where for many years was the only bridge crossing the Thames west of London Bridge. Unfortunately, owing to the difficulty of carrying a good road over the Weald Clay, it was late before Dorking was put into easy communication with the south. In 1750 the people of Horsham presented a petition to Parliament for a good carriage-road towards Dorking, on the plea that if they wanted to reach London, the only way open to them was to go south to the coast, and then round by Canterbury! The Horsham Petition was not in vain, for it produced in 1755 a Turnpike Act for making the road from Horsham to Dorking, through Capel. Any prosperity accruing to Dorking from this concession was doomed to be short-lived, for even in these early days the race to London had begun. We find Cobbett in 1822 lamenting the fact that road-makers were cutting

through Reigate Hill in order to save a few minutes in the run between London and Brighton! Probably the cutting alluded to is the one crossed by a suspension bridge near the top of Reigate Hill.

The most modern and progressive town in the district is Redhill, which has developed at a point where important east-to-west routes intersect those running from north to south. Mr. Chisholm, in his most interesting paper on the position of villages and towns in this part of England, has shown how modern developments have made the railway town of Redhill a necessity. Redhill may be regarded as the industrial counterpart of Reigate, which in turn is the residential or "West End" area of Redhill.

Blechingley, Nutfield, and Godstone are examples of villages developed at cross-roads. The two former are high and dry on the Sandstone ridge; and we may well ask why are they there rather than on the water-bearing Selbornian strata in the valley. Probably the correct answer to this is that the said strata were in Saxon times far too marshy for human settlement. Indeed, there is every reason to believe that one wide marsh extended from the foot of the Sandstone ridge towards Merstham; for this district is even now frequently water-logged, and bears in places

a variety of marsh-plants and occasional withy-beds. Moreover, on maps less than fifty years old, Nutfield Marsh is distinctly marked, and the name Merstham, or Merestan, as it was called in Domesday, suggests the same conditions over a comparatively wide area.

Some villages seem to owe their existence to proximity to a stream which could furnish power for turning mills. The area is one in which water-power apparently died a lingering death—a fact easily explained by the comparative distance of the coalfields, and the bad condition of the roads. Even in this twentieth century, the rhythmical plash of the water-wheel may be frequently heard both in the valley of the Mole and in that of the Tillingbourne. Villages once noted for their water-mills are Horley—now fast growing into a prosperous town — Betchworth, West Humble, Mickleham, Stoke D'Abernon and Church Cobham. Though some of these mills still cling to water in preference to steam power, they have almost all substituted steel rollers for the mill-stones which formerly did the grinding. In consequence, one may see in many villages the disused mill-stones doing duty as flag-stones, garden and door steps (Plate X.).

In an area where, owing to so large a proportion of the surface being occupied by pervious rocks,

Photo by Mr. H. B. Bond.

1. Bridge over the Surrey Iron Railway, near Merstham (p. 74).

2. Horses drawing a train of waggons on the Little Eaton Railway (p. 73).

there is trouble in finding water, it is natural to find lines of villages grouped on the water-bearing strata. Before modern civilisation made such demands on the formations nearest to the surface, the rocks were saturated at a much higher level than they are to-day. Hence, we find Great and Little Bookham, Fetcham, Ashtead, and Epsom, all grouped on the narrow outcrop of the Woolwich Beds, which doubtless furnished an adequate supply of water in early times. Most of these villages are now dependent upon the pumping-station at Leatherhead, which ensures to them a regular supply from the deeper strata.

CHAPTER VIII

DISTRIBUTION OF POPULATION

The statistics given in the Appendix show that as regards population, parishes group themselves in three classes, according to whether they are of the advancing, fluctuating, or retrograde type.

Accessibility to London seems to be the chief factor in determining the *advancing* group. Places which in the times of early occupation were tabooed for human settlement on account of difficulty in obtaining water, are now occupied by an overflow from the London suburbs, consisting of the more leisured, or perhaps the more health-loving types of the community.

Thus, improved methods of locomotion and of obtaining water have wrought changes which have converted a former *hindrance* into a positive *inducement* to human occupation—an inducement with added significance when we consider how large an area towards the north is occupied by the damp, fog-haunted London Clay!

The building of the Chipstead Valley line has wrought great changes at Kingswood, Chipstead,

and Tadworth. No data are at present available for showing the increase of population during the present decade, but at the next census (1911) we may expect to find a marked increase in this region, where the builder's hammer is now never silent. Other parishes becoming steadily suburban in character are Walton-on-the-Hill, Merstham, Caterham, Woldingham, Warlingham, Coulsdon, and the northern parishes generally. It may be a matter of surprise to find also a small colony of the suburban type at Horley, on the southern confines of the sheet, where the population nearly trebled between 1871 and 1901. The chief explanation of this is that Horley stands on the main line to Brighton, and though farther from London in actual miles than such a place as Godstone, it is nearer in time—a consideration of far greater importance to busy men. Horley, moreover, offers such attractions as golfing, fishing, and racing, the Gatwick Racecourse being quite near.

Coulsdon, owing to greater proximity to the capital, has during the same thirty years quadrupled its population, and, judging from the energetic building operations now going on, will show a still more marked increase at the next census.

Godstone, Horne, and Woldingham belong to the fluctuating type, for though on the whole they

show an increase during the thirty years 1871 to 1901, yet a slight decrease is noticeable between 1881 and 1891. This is probably due to the fact that about 1871, railway operations in the neighbourhood attracted to these villages large numbers of workmen, whose presence for a term of years would give an unnatural rise to the census returns, followed by a no less marked fall when the men took their departure.

The retrograde character of Leigh and Wotton can be understood when we consider their almost entire dependence on agricultural pursuits. Surrey is not by any means alone in showing a somewhat alarming decrease of population in its more remote rural districts. Depression in agriculture accounts not only for these two parishes, but also for some of the others which show a decrease between 1871 and 1881, though since then, owing to improved railway communications, they have gone steadily forward.

Parishes.

After a careful comparison of the Parish Map with Maps I. and II., it will be seen that the parish boundaries are in no small degree determined either by the geological structure of the country, by relief, or, as very commonly happens,

by a combination of both. It has already been shown that the place-names of parishes which stretch southwards to the Chalk escarpment have certain features in common, and that those of the southern part are no less distinctive in character. It is not surprising, therefore, to find, when we come to look at the parish boundaries, a well-defined east-to-west medial line running from Effingham to the detached portion of Tandridge, where it is broken by the intrusion northwards of an elongated, somewhat head-shaped portion of Godstone. Between Caterham and Warlingham, and also between Coulsdon and Warlingham, there is a deep valley, doubtless forming in the early days neutral territory, ensuring the security of the two adjacent settlements.

Oxted extends northwards beyond the escarpment in a small handle-shaped piece of land, which suggests that it may also have been neutral territory between Woldingham and Limpsfield. Thus, it would appear that Tandridge, Godstone, and Oxted have each annexed unappropriated land to the north of the escarpment, in this manner breaking the east-to-west line mentioned at the beginning of the chapter.

The next thing which strikes one with regard to the shape of the parishes, is that very commonly they extend for five, six, or more miles from north

to south, with a width quite disproportionate to their length, dwindling down in the case of Little Bookham to a width of less than half a mile.

Why should the land be cut up in these north-to-south strips rather than in the contrary direction? Again, we find the ultimate cause for this to lie in the geological structure, which, owing to the different degrees of permeability in the constituent rocks, determines whether they are water-bearing or non-water-bearing, and therefore eventually determines the kind of vegetation they will support. Obviously, it would be poor economy in a country where the rocks strike from east to west, to allow the parish boundaries to coincide with this direction. Hence nearly all the parishes have been apportioned in such a manner as to give to each as great a variety of soil, and hence of vegetation, as possible.

Reference has already been made to the way in which the contour-lines arrange themselves, like the roots of a great tree, converging towards Croydon. These contours represent steep-sided valleys, which proved very useful in delimiting parish boundaries. Hence Coulsdon gets its battledore-shaped outline from the fact that the valley-way, curving gracefully under Riddlesdown, lies to the north-east, whilst that curving no less gracefully, but in the opposite direction,

through Smitham Bottom, lies to the north-west.

Judging from its curious shape, one cannot but conclude that Banstead was a piece of ground least to be desired, and therefore last to be appropriated. The surrounding parishes appear to have cut slices on all sides from this undesirable part, leaving the very unsymmetrically-shaped parish of Banstead in the middle.

Its undesirability to the agriculturist arises from two things: first, it has extensive tracts of fine sand running from north to south; and, secondly, much of it lies above the 500-foot contour, on Chalk, where it is too dry for any animals but sheep to find sufficient pasturage, and where wells have to be dug deep, and are in consequence difficult to work (Plate VIII.).

In a country so destitute of streams of any description it is not surprising to find, when we come to examine the River Mole, that it usually *separates* parishes, thus allowing the largest possible number to be benefited by it.

The parishes thus separated are Horley from Charlwood; Horley and Leigh from Buckland (detached); Reigate, Leigh, Dorking Rural, and Buckland from Betchworth; Fetcham from Leatherhead; and the Bookhams from Stoke D'Abernon.

CONCLUSION

"BOTH he who sees his friend at a distance, and he who sees him near at hand, are sure of the identity of the person seen; but there are errors possible to the first which are not possible to the second; and close and intimate acquaintance lends to every part of judgment a surety which distant and general acquaintance wholly lacks. The one can say something true, and say it briefly; there is no more to say. The other can fill in and fill in the picture until, though perhaps never complete, it is asymptotic to completion."

So writes Mr. H. Belloc with regard to History. The words are peculiarly applicable to Geography. We need to see our friend *near*, to study him in all his moods, to learn what is essential about his past, because only in knowing the past can we rightly interpret the present, and to learn about the present, for only in this way can we gauge possibilities for the future.

In the foregoing chapters much time has been

spent in studying a small portion of the Earth's surface, and the question naturally arises, "Is it worth while?" Experience proves that it is most emphatically worth while. In all departments of science, the detailed study of a small part is found to lead to the only intelligible interpretation of the whole.

The call for systematised training in map-reading and visualisation of land-forms was never greater than it is to-day; and whilst it is true that the more laborious part of this work can and must be done in the class-room, it is also true that in order to ensure accuracy of conception, one must go out, map in hand, and compare the land-forms actually *seen* with those represented on the map. The very conditions of our social environment tend seriously to limit our range of vision—a defect which proved a great drawback in the late South African War. In many directions an effort is being made by various organisations outside the schools to correct this and other similar physical disabilities. If the schools would include a course of outdoor training in a subject like geography, they would confer on the uprising generation a benefit, the effects of which, both moral and physical, it is impossible to exaggerate. The habit of classifying and co-ordinating apparently unrelated facts trains the mind to regard no

single occurrence as isolated or unimportant ; the individual learns to apply methods of scientific induction used for a small area to the world at large ; he thus acquires that breadth of outlook which fits him for true citizenship and for dealing with the affairs of future days.

APPENDIX

AVERAGE RAINFALL FOR TEN YEARS (1897-1906).

	Altitude in Feet.	*Rainfall in Inches.*
Oxshott	206	23·4
D'Abernon Chase	280	25·0
Brockham	160	25·4
Reigate (Hartswood)	174	25·5
Nutfield (Holmdale)	500	25·9
Reigate (Aldersyde)	(?)	26·0
Reigate (Earlswood)	196	26·4
Nutfield Priory	468	26·4
Reigate (Woodhatch)	270	26·5
Reigate (Nutwood)	440	26·6
Redhill (Oxford Road)	300	26·7
Dorking (West Street)	224	26·6
High Ashurst	550	27·3
Merstham (Rockshaw)	475	27·7
Chelsham	600	27·7
Kenley	282	27·9
Reigate Castle	350	28·4
Dorking (Ringly Mead)	(?)	28·6
Banstead	488	28·7
Betchworth	322	28·7
Reigate Wray Lodge	316	29·0
Merstham (Harp's Oak Cottage)	454	29·0
Leatherhead	250	29·0
Chaldon Rectory	542	29·2
Chipstead	550	29·3
Dorking (Fir Tor)	260	29·5
Abinger Hall	320	30·2
Warlingham	614	30·2
Dorking (Denbies)	610	30·4
Abinger Rectory	381	30·5
Caterham Asylum	610	30·5
Woolpit	600	31·0
Feldemore	505	31·0
Caterham Valley	600	32·3
Joldewynds	550	32·8

POPULATION.

	Area in Acres.	1871.	1881.	1891.	1901.	*Persons per Acre.*	*Persons per Sq. Mile.*
Abinger	7577	1167	1172	1394	1506	0·19	121·6
Ashtead	2651	906	926	1351	1881	0·71	454·4
Banstead	5550	1668	3826	4560	5624	1·13	723·2
Betchworth	3743	1558	1779	1868	1789	0·47	300·8
Blechingley	5439	1916	1856	1857	2128	0·39	249·6
Bookham, Great ..	3294	1089	1068	1172	1351	0·41	262·4
Bookham, Little ..	929	197	214	234	223	0·23	147·2
Buckland	1876	385	401	497	498	0·26	166·4
Burstow	4760	1098	1200	1225	1489	0·31	198·4
Capel	5695	1271	1340	1549	1448	0·25	160·0
Caterham	2438	3577	6259	7298	9486	3·89	2489·6
Chaldon	1644	165	185	280	266	0·16	102·4
Charlwood	6901	1456	1359	1438	1710	0·24	153·6
Chelsham	3357	399	448	440	467	0·13	83·2
Chipstead	2420	628	644	688	640	0·26	166·4
Cobham	5332	2133	2319	2978	3901	0·73	467·2
Coulsdon	4314	1591	2589	4450	6523	1·51	966·4
Crowhurst	2119	250	426	246	243	0·11	70·4
D'Abernon, Stoke ..	2038	356	408	527	571	0·28	179·2
Dorking	1339	8574	9577	7132	7670	5·72	3660·8
Dorking Rural ..) Holmwood and Westcott)	8676	—	—	3762	3740	0·43	275·2

Effingham	3183	566	585	620	539	0·15	96·0
Epsom	4424	6276	6916	8437	10915	2·49	1593·6
Farley	1051	127	88	110	119	0·11	70·4
Fetcham	1839	487	472	526	461	0·29	185·6
Gatton	1232	207	222	218	213	0·17	108·8
Godstone	6830	2254	2548	2478	2800	0·41	262·4
Headley	1640	337	339	415	394	0·24	153·6
Horley	7982	1946	2385	3345	4133	0·51	326·4
Horne	3932	672	698	663	714	0·18	115·2
Kingswood	1820	321	387	608	754	0·41	262·4
Leatherhead	3508	2455	3533	4305	4694	1·33	851·2
Leigh	3419	560	523	508	541	0·15	96·0
Lingfield	9239	—	—	3204	3718	0·40	256·0
Merstham	2663	959	903	962	2015	0·75	480·0
Mickleham	2846	780	799	815	750	0·26	166·4
Newdigate	4744	698	664	687	623	0·13	83·2
Nutfield	3583	1224	1093	1667	1860	0·51	326·4
Ockley	3008	602	623	615	565	0·18	115·2
Oxted	3659	1164	1727	1499	2098	0·57	365·8
Reigate	5994	15916	18662	22646	25993	4·32	2764·8
Tandridge	3928	623	605	589	628	0·53	339·2
Walton-on-the-Hill ..	2608	543	616	694	839	0·36	230·4
Warlingham	1703	773	1147	1488	2573	0·15	96·0
Woldingham	684	82	132	101	220	0·32	204·8
Woodmansterne ..	1591	276	306	408	534	0·25	160·0
Wotton	3796	711	692	655	608	0·16	102·4

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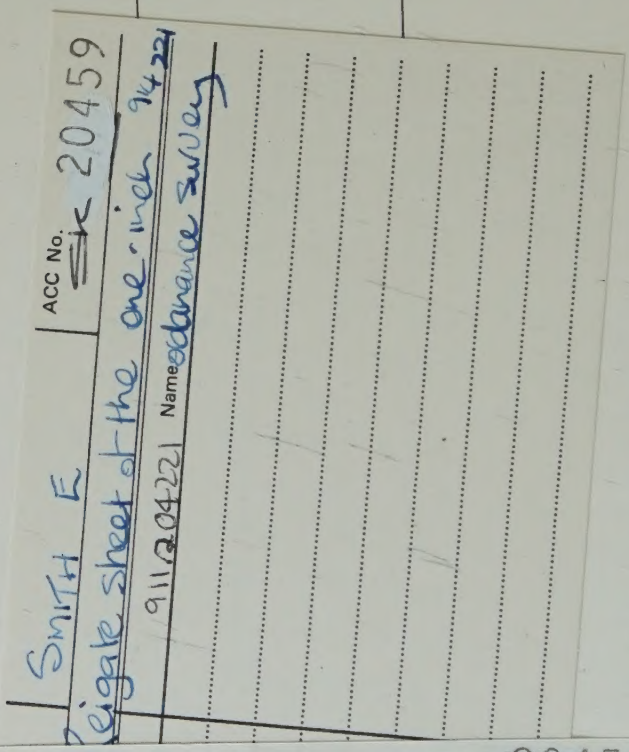

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